SCIENCE ABSTRACTS.

Section A.—PHYSICS.

DECEMBER, 1932.

GENERAL PHYSICS.

4716. Alternative to the Rejection of Observations. H. Jeffreys. *Roy. Soc., Proc.* 137. *pp.* 78–87, *July* 1, 1932.—A method is given for dealing with sets of observations appreciable fractions of which are affected by a systematic error. Each observation has the probability $(1 - m)$ that it is a shot at the true value x, and the probability m that it is a shot at the value $x + y$, where y is the systematic error. The shots at x are distributed in accordance with a Gaussian normal error law with modulus h, and similarly for the shots at $x + y$ an error law with modulus k applies. A method of solution for the five unknowns m, x, y, k and h is developed. An approximate solution may also be obtained by a method of weighting, the weight of an observation being a continuous function of its deviation. W. S. S.

4717. Units of Measurement. E. Brylinski. *Congrès International d'Électricité, Paris, Sect.* 2. *Comm. No.* 1C1. [16 *pp*.], 1932.—A discussion of standard systems of units of measurement, mechanical, electrical and magnetic. J. J. S.

4718. Interconversion Factors for Numbers in Energetic and Related Units. C. H. D. Clark. *Phil. Mag.* 14. *pp.* 291–297, *Aug.*, 1932.—Energy values may be quoted in a variety of different ways, and the conversion from one system into another enters into many types of practical work and calculation. A table which has been found convenient in such actual cases is put forward, and a number of examples of its use are given. A. H.

4719. Limits of Physical Observation. F. Ehrenhaft. *Phys. Zeits.* 33. *pp.* 673–682, *Sept.* 15, 1932.—A lecture before the Vienna Chemical Physical Society on the determination of the weight and charge of individual sub-microscopic bodies. By observing the rate of their steady fall through a gas at high pressures their mass, of the order of 10^{-13} gm., can be determined with great accuracy. The observations are analysed by Karman's method, and Stokes' law is discussed. Applied to the determination of the fundamental electric charge, the method gives no uniform minimum value. New experiments on photophoresis are also described.

C. B. A.

4720. Quartz-Thread Gravity Balance. R. Threlfall and A. J. Dawson. *Roy. Soc., Phil. Trans.* 231. *pp.* 55–73, *July* 3, 1932.—An account of experiments made with a quartz-thread gravity balance at Kew Observatory and the National Physical Laboratory. The value of g is compared at the two places. [See Abstract 990 (1900).] G. G. S.

4721. Foucault Pendulum with Maintained Amplitude and the Measurement of its Apparent Rotation. W. C. Baker. *Rev. Sci. Instruments*, 3. *pp.* 444–450, *Aug.*, 1932.—The amplitude of the pendulum is maintained by a combination of Wilberforce's method of raising the bob at the mid point of its path and lowering at extreme elongation with Charron's method of periodic impulses given to the bob at the mid-point of its path by electrical and magnetic methods [see Abstract 1778 (1931)]. The moment of inertia of the bob about the mid-point of suspension is lessened at the mid-point of each swing, and (in consequence of conservation of angular momentum) it acquires an increase of angular velocity. Consequently the energy lost during the previous half-swing is restored to it, and the oscillation is maintained. The measurement of the rotation of the plane of vibration about the local vertical is obtained by observation of the shadow of the wire of the vibrating pendulum. Details of the mechanical construction and electrical circuits are given and illustrated. R. S. R.

4722. Isochronism of Electric Clocks. C. Féry. *Congrès International d'Électricité, Paris, Sect.* 12. *Comm. No.* 18*C*2. [5 *pp.*], 1932.—Lippmann in his classical treatment of the isochronism of a free pendulum [see Abstract 4 (1899)] has shown that the condition of isochronism is not disturbed by impulses applied while the pendulum is passing through the vertical position. The author points out that this conclusion is only valid in so far as the period is independent of the arc of swing. Experimental work has shown that isochronism in practice is best maintained if impulses are applied *after* passage of the pendulum through the vertical position [see Abstract 675 (1905)]. This result is here derived theoretically, and its application to pendulums maintained electrically in oscillation is briefly discussed. [See also Abstract 2218 (1932).] J. S. G. T.

4723. Delay in Registration of Hourly Signals. R. Jouaust. *Bull. Géodésique, No.* 31. *pp.* 181–184, *July, Aug., Sept.*, 1931.—At the Bureau Internationale de l'Heure delays in the registration amount to 0·005 sec., and these remain variable with the receiving apparatus. The delays may be (1) electrical, due to the use of resonance arrangements to eliminate interference, or to the use of the shunted condenser with a triode arrangement, or (2) mechanical, due to the inertia of the moving parts or friction of the pen on the chronograph. Two methods are described, by which the errors may be eliminated, the registration of the signal and the pendulum being made with the same or different pens, while the error may be determined as at the Paris Observatory by the Blondel oscillograph. R. S. R.

4724. Standard Time Throughout the World. *Bureau of Standards, Circ.* 399. [18 *pp.*], *Sept.* 15, 1932.—This paper gives a brief historical sketch of the development of the standard-time system, a map showing the time-zone boundaries in the U.S.A., and a list of the official stations sending out radio time-signals. The legal time in nearly every foreign country and in most of the more important islands is also given, compared with both Greenwich mean time and with noon, eastern standard time.

4725. Interfacial Tensions and Orientation of Polar Molecules. Parts VII and VIII. A. Taubmann. *Zeits. f. phys. Chem.* 161. *Abt. A.* 1–2. *pp.* 129–146, *Aug.*, 1932.—By a drop method, as in previous work [see Abstract 3260 (1930)] the interfacial tensions at the surfaces separating (*a*) benzol and (*b*) hexane, from aqueous solutions of *p*-toluidine are measured. The adsorption isotherms are calculated, and the results compared with those previously obtained for *p*-toluidine-air surfaces. The isothermals of interfacial tension or adsorption show no point of inflection, and Langmuir's adsorption equation is more nearly followed by these than by the previous results with air. When the surface is completely saturated the calculated dimensions of the *p*-toluidine molecule are the same for all surfaces of separation. In Part VIII a method is described whereby the concentration of capillary-active materials in aqueous solutions may be determined by titration. The progress of the titration is checked by observations on the surface or interfacial tensions of the solution. These attain maxima when all the dissociated molecules have disappeared. J. P. A.

4726. Capillary Activity and the Electrical Properties of Molecules. W. K. Sementschenko. *Kolloid Zeits.* 60. *pp.* 177–180, *Aug.*, 1932.—In considering the effect on one molecule of the molecular field of another, it is necessary to consider not only the dipole moment, but also the geometrical properties of the molecule. In applying this view to the study of capillary activity a generalised Langmuir equation is developed. The equation indicates that molecules with the smallest generalised moment will be adsorbed, and that their capillary activity increases as the difference between the generalised moments of the solvent and solute increases. F. J. W.

4727. Action of Gases in Liquids. H. Rudolph. *Kolloids Zeits.* 60. *pp.* 308–317, *Sept.*, 1932.—The velocity and action of bubbles formed in liquids is considered with respect to the character of the porous medium and the liquid; the excess pressure and the height of the liquid. Quantitative relations are given for a water-air system and tables and graphs reproduced. The results may be applied technically in the economic production of gases in liquids. H. M. B.

4728. Flow of Subterranean Water. K. Kitagawa. *Kyoto Coll. Sci., Mem.* 15. *pp.* 203–214, *July*, 1932. *In French.*—To obtain a theory for the flow of water underground, it is assumed that it passes through capillary tubes in the sub-soil and obeys Poiseuille's law. If the soil is supposed to be made up of sand particles of diameter d, three ways in which the particles may lie are chosen as the most probable and considered separately. Then the formula $V = 31\cdot 89 d^2\eta/\mu R$ m. per day gives the velocity of flow for a slope η, viscosity μ and width R. If the diameter of the capillary tubes increases then Forchheimer's formula is obtained, $\eta = aV + bV^2$. The theoretical values agree with experiment. H. M. B.

4729. Flow of Liquids through Porous Media under Gravity. R. D. Wyckoff, H. G. Botset and M. Muskat. *Physics*, 3. *pp.* 90–113, *Aug.*, 1932.—Sand was contained in a vessel with vertical sides, shaped in plan like the sector of a circle. At the wide end is a water reservoir, and at the narrow end a space representing the section of an oil well. The pressure was measured at 20 points along the base, on the central radius, as well as the total flow. The results show that the outflow is proportional to the square of the differences in the fluid heads. The effect of additional pressure applied in addition to the gravity flow is also investigated and the results are examined theoretically. J. H. A.

4730. Capillary Flow Through an Ideal Uniform Soil. W. O. Smith. *Physics*, 3. *pp.* 139–146, *Sept.*, 1932.—An ideal soil is an assemblage of spheres packed to a definite porosity, and for statistical purposes may be represented by grains placed in hexagonal array, with adjacent grain centres equidistant and at a distance $(2r + d)$, where r is the grain radius and d a spacing constant adjusted to suit the observed porosity. Three sets of capillaries, found to extend continuously throughout the packing, furnish the channels through which fluid crosses the soil body. The velocity through the mean capillary is calculated by a method essentially due to Slichter; and from this quantity, the sectional area of the mean capillary and the number of capillaries per cm.^{2}, the quantity of fluid per sec., f, crossing a soil of section area s and length L, is found to be $f = 0{\cdot}00809(1 - \mathrm{P})^{2/3}\{0{\cdot}9850/(1 - \mathrm{P})^{2/3} - 1\}^2 \Delta p \mathrm{D}^2 s/\eta \mathrm{L}$. P is the porosity, D the diameter of the grains, η the viscosity of the fluid, and Δp the pressure difference under which the flow occurs. Intrinsic permeabilities computed from this equation are compared with values for carefully sized glass spheres and quartz sands observed experimentally by Green and Ampt. A further comparison with corresponding values calculated from Slichter's equation is given. AUTHOR.

4731. Penetration of Hydrogen Through Steel at 4000 Atmospheres. T. C. Poulter and L. Uffelman. *Physics*, 3. *pp.* 147–148, *Sept.*, 1932.—A study is made of the penetration of hydrogen through a very fine grained steel as compared to the usual grade of steel used in the construction of pressure equipment. The penetration is studied in specially constructed cylinders and found to take place at much lower pressure than had previously been recorded. The penetrating effect of hydrogen is observed at as low as 4000 atmospheres, whereas 9000 atmospheres is the lowest pressure previously recorded for this effect. AUTHORS.

4732. Properties of Porous Building Materials. Part VI. E. Madgwick and C. G. Webb. Part VII. E. Madgwick. *Phil. Mag.* 14. *pp.* 486–496, *Sept.*, 1932.—A continuation of previous work. Part VI describes automatic apparatus for recording the results of absorption experiments which may last for eight hours or more. Part VII deals more generally with the problem of damp walls than the earlier papers have done. It is shown how to calculate the likelihood of deposition of moisture in the case of any given material of which the constants are known, and how to estimate the effect of applying a coating of another material to the surface. J. H. A.

4733. Effect of Temperature on Skin-Friction. J. H. Lamble. *Inst. Naval Architects, Trans.* 74. *pp.* 291–299, *March*, 1932. *Engineering*, 133. *pp.* 470–471, *April* 15, 1932.—The variations with temperature of the skin-friction resistance of a flat plate 48 in. × 7·7 in. with streamlined edges immersed in a turbulent stream of water has been investigated experimentally. At all rates of flow (1–2ft. per sec.) the resistance diminishes slowly with rise of temperature from 40° to 100° F. Since turbulent flow is independent of viscosity and therefore of temperature, the observed effect is concerned only with the boundary layer, and is probably a combination of reduced shear resulting from reduction of the

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viscosity and increased shear due to reduction of thickness of the layer consequent upon the reduced viscosity. Curvature of the plate probably causes a change of thickness of the boundary layer, and results in a greater temperature effect. The distribution of velocities in the wake of the flat plate has been studied; throughout the length of the plate the flow is practically undisturbed at a distance of $1\frac{1}{2}$ in. from the plate. H. F. G.

4734. Laws of Flow of Gas Jets. M. Roy. *Comptes Rendus*, 195. *pp*. 300–302 *July* 25, 1932.—A mathematical treatment of the problem of the flow of a perfect gas from a narrow orifice into an extended enclosure where the pressure is uniform. J. W. T. W.

4735. Theory of Flow of Very Rarefied Gases. R. Darbord. *J. de Physique et le Radium*, 3. *pp*. 345–354, *Aug.*, 1932.—The theory of molecular flow in a rarefied gas is made to depend upon the solution of a problem of geometrical probability. For example, in the case of the flow along the length of a capillary tube, if a molecule enters at one side of the tube, what is the probability of its coming out at the other side? In a similar way it is shown that with a minimum of hypothesis the physical meaning of Knudsen's law can be clearly demonstrated, and the law can even be easily generalised. T. B.

4736. Vapour Viscosities of the Two Common Pentanes, Two Pentenes, and Carbon Tetrachloride. W. M. Bleakney. *Physics*, 3. *pp*. 123–136, *Sept.*, 1932.—The present work is a continuation of the investigations begun by R. K. Day [see Abstract 3082 (1932)] on the behaviour of vapours by means of accurate viscosity measurements. The instrument, designed and built by him, has been improved, and his results on normal and iso-pentane have been verified. In addition, measurements on two pentenes, similar in structure to the pentanes, have been made at room-temperature, and the viscosity-pressure curves for all four hydrocarbons and also for CCl_4 have been obtained at 100° C. A linear relation, with a negative slope, persists in all these curves, the slope for the hydrocarbons being considerably less at the higher temperature, while the curve for CCl_4 is comparable to those for the hydrocarbons at room-temperature. A table is given of the values of the constants in the equation $\eta = \eta_0(1 - \alpha p)$, the pressure being expressed in atmospheres. AUTHOR.

4737. Effect of an Axial Wire on the Flow of Water through a Circular Pipe. A. Fage and H. C. H. Townend. *Phil. Mag.* 14. *pp*. 500–508, *Sept.*, 1932.—Lea and Tadros have found that the reduction of flow of water in a circular pipe, at low Reynolds numbers, due to an axial wire, is considerably less than that predicted by the theory of stream-line flow [see Abstract 2912 (1931)]. Measurements of water flow, with and without an axial wire, by the present authors, do not confirm the results obtained by Lea and Tadros. The rate of discharge in the presence of an axial wire is now found to be in close agreement with the theoretical rate. Examination of the flow by means of the ultra-microscope showed no concentration of turbulence near the wire. J. S. G. T.

4738. Experimental Study of the Motion of Water in a Vertical Tube and of the Circular Waves Produced on the Surface of Water. J. Baurand. *Ann. de Physique*, 18. *pp*. 107–197, *Sept.*, 1932.—A column of water is allowed to descend in a vertical tube with its lower end immersed

in water; the motion of the column of water in the tube and of the waves produced on the surface of the water surrounding the tube is investigated experimentally. A formula giving the period of oscillation of the water in the tube is derived. The periodic progressive waves formed on the surface of the water surrounding the tube satisfy, to a first approximation, the requirements of Kelvin's theory. The Rayleigh-Gouy expression for the group-velocity of the waves in terms of the phase velocity is confirmed.
J. S. G. T.

4739. Laws of Turbulent Flow in Smooth Tubes. J. Nikuradse. *Forschung. Ing. Wes.* 3. *No.* 356. [36 *pp.*], *Sept.-Oct.*, 1932.—The laws of flow in smooth cylindrical tubes are investigated for values of Reynolds number R up to 3240×10^3. The exponent in Prandtl's equation $u = ay^n$, where u is the velocity of flow and y the distance from the wall, is constant at 1/7 for values of R up to 100×10^3, except that for very small values it is somewhat greater; for higher values n decreases, becoming 1/10 at 3240×10^3. For all values of R the equation $\phi = \phi(\eta)$ is applicable, where ϕ, the "dimensionless velocity of flow," $= u/v_*$, $\eta = v_* y/\nu$, and $v_* = \sqrt{\tau_0/\rho}$, τ_0 being the shear stress at the wall, ν the kinematic viscosity, and ρ the density. The Blasius equation $\lambda = 0{\cdot}316/R^{0 \cdot 25}$ has been verified for values of R up to 100×10^3, but for greater values of R a more satisfactory equation is $\lambda = 0{\cdot}0032 + 0{\cdot}221/\mathrm{R}^{0 \cdot 237}$. Various other relationships, including that between the mean and maximum velocities, are discussed at length.
H. F. G.

4740. Growth of Waves on Water Due to Wind. T. Stanton, Dorothy Marshall, and R. Houghton. *Roy. Soc., Proc.* 137. *pp.* 283–293, *Aug.* 2, 1932.—Experiments are described on the behaviour of a water surface over which a wind is blowing at speeds between 300 and 800 cm. per sec., and on the measurement of the distribution of the normal pressure of the wind on the surface of models of the waves. The relation between wave-length and wave-velocity is approximately the same as that derived theoretically on the assumption that the water behaves as a perfect fluid moving irrotationally, the motion of the air being neglected. The pressure distribution on the model wave surface exhibits large second harmonics, which would cause the profile of waves on water to differ considerably from a simple harmonic curve.
H. F. G.

4741. Motion of Vortices in a Channel Bounded on One Side. A. Kneschke. *Ann. d. Physik*, 14. 6. *pp.* 655–666, *Aug.* 30, 1932.—Routh's function and the method of conformal representation are applied to discuss the motion of a single vortex or vortex pair in fluid on one or either side respectively of a plane boundary confining the fluid.
J. S. G. T.

4742. Diffusion of Sodium Chloride in Aqueous Solutions. L. J. Burrage. *J. Phys. Chem.* 36. *pp.* 2166–2174, *Aug.*, 1932.—The diffusion coefficient of NaCl in aqueous solution has been measured over the concentration range 0–6*M*. The diffusion coefficient is a minimum at a concentration of about 1·5*M*. The diffusion coefficient 0·1*M* HCl has also been measured.
F. J. W.

4743. Velocity of Diffusion in Gelatin Gels as a Function of the Viscosity of the Dispersing Medium. E. Hatschek. *Kolloid Zeits.* *pp.* 273–276, *Sept.*, 1932.—The velocities of diffusion of potassium

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chromate in gelatin gels of the same gelatin content prepared by adding aqueous solutions of glycerin of different strengths to gelatin are determined experimentally. The respective viscosities of the aqueous glycerin solutions were as follows (the subscripts indicating the percentage of glycerin present): $\eta_{10} = 1\cdot364$; $\eta_{20} = 1\cdot912$; $\eta_{30} = 2\cdot906$; $\eta_{40} = 4\cdot370$. Lead acetate was used as indicator. Theoretically, the range to which diffusion proceeds in a given time should be inversely proportional to the viscosity of the dispersing medium. Experimentally it is found that the ratios of ranges so calculated are throughout greater than the values of these ratios determined experimentally, the discrepancy between theoretical and experimental values of the ratios increasing with increasing glycerin content. The most reasonable explanation of this result appears to be that "solid" phase is hydrated to a decreasing amount as the glycerin content of the gel increases. This process increases relatively the cross-sectional area available for the diffusion process and reduces the viscosity of the gel below that of the dispersion medium as the gelatin content is increased. J. S. G. T.

4744. Knudsen Manometer. E. Fredlund. *Ann. d. Physik*, 14. 6. *pp.* 617–643, *Aug.* 30, 1932.—It is assumed from previous work [see Abstract 4036 (1932)] that, in the Knudsen manometer, the manometer vessel must be small compared with the mean free path λ of the gas molecules. It is now shown that there is a linear relation between the gas pressure and manometer deflection up to pressures such that the ratio λ/l is about 13. Here l is the distance between the hot plate and the movable plate. The influence of the accommodation coefficient on the indication of the instrument is investigated. J. H. A.

4745. Manometer with Non-Volatile Liquid of Low Density. C. G. Malmberg and W. W. Nicholas. *Rev. Sci. Instruments*, 3. *pp.* 440–443, *Aug.*, 1932.—Closed end manometers utilising organic liquids instead of mercury have the disadvantage that gas dissolves in the liquid and eventually accumulates in the closed end. A manometer is described with which the removal of gas from the liquid and from the closed end is quickly and effectively accomplished. AUTHORS.

4746. New Type of Vacuum or Circulating Pump. E. L. Harrington. *Rev. Sci. Instruments*, 3. *pp.* 476–482, *Sept.*, 1932.—A new type of vacuum or circulating pump employing a helical tube made to rotate about the axis of the helix is described. Its action depends on a pumping liquid which fills the lower bends of the helix and crowds out the gas being pumped as the helix is rotated. There is a provision for the return of the pumping liquid to the first coil of the helix as the latter continues to rotate. The liquid may be chosen to suit the work at hand. Among the advantages claimed for the pump are the following: mercury vapour is not employed, heating and cooling elements are not required, adapted equally well to corrosive and non-corrosive gases, vapours and liquids, constant personal attention is not needed, it may be started or stopped instantly without the use of stop-cocks, and its action is reversible. AUTHOR.

4747. Photoelastic Measurements on Glass and Glass-Metal Joints. P. Tarbès. *Comptes Rendus*, 195. *pp.* 222–224, *July* 18, 1932. —The method consists in measuring the strains developed by the double refraction produced. A new form of mica compensator is described for the measurement of double refraction. The method is capable of measuring large effects, and is highly accurate. J. E.

4748. Stresses in a Wire Wheel with Non-Radial Spokes under Loads Applied to the Rim. A. J. S. Pippard and [Miss] M. J. White. *Phil. Mag.* 14. *pp.* 209–233, *Aug.*, 1932.—In continuation of previous work [see Abstract 2151 (1931)], in which the stresses in a radially spoked wire wheel caused by a radial load on the rim were deduced, the authors here consider the general problem of a wire wheel having spokes inclined at a constant angle (positive or negative) to the radius. Two cases are discussed, *viz.*, those in which the rim is loaded either radially or tangentially. The analysis contemplates a wheel having an infinite number of spokes, and the results obtained are applied to wheels having 4, 5, 9, 12 and 17 spokes. [See following Abstract.] J. S. G. T.

4749. Stresses in a Wire Wheel under Side Loads on the Rim. A. J. S. Pippard and W. E. Francis. *Phil. Mag.* 14. *pp.* 436–445, *Sept.*, 1932.—In continuation of previous work [see preceding Abstract], the authors investigate mathematically the stresses in a wire-spoked wheel when loads are applied to the rim normal to the plane of the wheel. The spokes may be either radial or non-radial, and for purposes of the analysis are replaced by two equivalent discs possessing certain elastic properties. The solutions obtained constitute good approximations for the stresses in wheels with finite numbers of spokes. J. S. G. T.

4750. Stresses in a Plate with a Flanged Circular Hole. K. Sezawa and K. Kubo. *Tokyo Univ. Aeronaut. Research Inst., Report, No.* 84. *pp.* 65–114, *Sept.*, 1932. *In English.*—As an approximation to the case of a flanged collar, in which collar and flange are of different depths, the case of a circular ring inserted in an aperture of a plate of the same thickness is considered, the elastic constants of ring and plate being in the ratio of depth of collar to thickness of plate in the corresponding practical problem. The stress distribution when the plate is stretched parallel to a given direction is worked out and illustrated by particular cases. Application to the case of an actual flange is then tested upon gelatin models. Theoretical results agree with these experiments if the depth of the collar is not great compared with the thickness of the plate. J. P. A.

4751. Stresses in Multiply Connected Plane Bodies. B. Meisel. *Comptes Rendus,* 195. *pp.* 511–513, *Sept.* 5, 1932.—When a force is applied to a point on the boundary of an aperture in a multiply connected body, the following principles are shown to hold, (1) the stresses σ may be represented by the sum of two functions, one depending only on the elastic constants, and the other only on the distance l from the point of application to a fixed point; (2) $\frac{\partial\sigma}{\partial l}$ is a function of l only; and (3) if in two geometrically similar bodies of different materials the points of application are chosen similarly, the difference between the two stresses produced at analogous points in the two bodies is always the same, and depends only on the elastic constants. J. P. A.

4752. General Solution of the Differential Equations of Elasticity. P. F. Papcovitch. *Comptes Rendus,* 195. *pp.* 513–515, *Sept.* 5, 1932.—The equations of Lamé are solved vectorially in terms of three harmonic functions. The solution constitutes a generalisation of previous attempts. J. P. A.

4753. Tensile Properties of Cast Nickel-Chromium-Iron Alloys and of Some Alloy Steels at Elevated Temperatures. W. Kahlbaum and L. Jordan. *Bureau of Standards, J. of Research,* 9. *pp.* 327–332, *Sept.,* 1932.—The tensile properties as measured in "short-time" tests were determined for a medium-manganese steel at 900° F.; for a series of cast nickel-chromium-iron alloys containing about 0·5 % carbon, 35 % chromium and from 10 to 45 % nickel, at a temperature of 1550° F.; and for three tungsten-chromium-vanadium steels and four molybdenum-chromium-vanadium steels at temperatures of 850° and 1000° F.

AUTHORS.

4754. Creep in Chromium-Vanadium Steels. W. Kahlbaum and L. Jordan. *Bureau of Standards, J. of Research,* 9. *pp.* 441–455, *Sept.,* 1932.—The creep in two tungsten-chromium-vanadium steels is observed over long periods up to temperatures of 1200° F. The highest stresses are sustained best by the steel of lower carbon content. Moreover the difference between the stresses producing a creep of 0·1 and 1·0 % is greater in this case. The results are fully illustrated in a series of graphs.

J. P. A.

4755. Recovery of Proportional Elasticity in Overstrained Steel. S. L. Smith and J. V. Howard. *Roy. Soc., Proc.* 137. *pp.* 519–530, *Sept.* 1, 1932.—A series of tests is made on fifty different steels to investigate their powers of recovery of proportional elasticity after having been strained beyond their yield points nine years ago, and allowed to rest unloaded since. Mild steel, with carbon up to 0·2 %, possesses the power of complete recovery irrespective of its previous mechanical and thermal history, and recovers in a comparatively short time. When the carbon content is between 0·3 and 0·7 %, recovery is slower and more limited. Quenching followed by reheating, or the presence of phosphorus, appears to prevent recovery. Eutectoid steels with 0·85 % carbon have no power of recovery. Recovery is independent of the state of stress of the test piece during the rest period.

J. P. A.

4756. Elastic Limit of Metals Exposed to Tri-Axial Stress. G. Cook. *Roy. Soc., Proc.* 137. *pp.* 559–574, *Sept.,* 1932.—A number of hollow cylindrical test pieces, all of the same size and of two different kinds of mild steel, are subject to simultaneous axial tension and internal hydrostatic pressure. It is shown that variations in the axial stress, provided that it remains the intermediate principal stress, have a negligible effect on the internal pressure required to cause initial failure at the internal surface. This result definitely favours the constant maximum shear stress theory of Guest, as distinguished from the theories of constant total strain energy, and of constant shear strain energy. A preliminary experiment shows that no change in elastic limit is produced in a wire of annealed iron by hydrostatic pressure up to 21·5 tons/sq. in.

J. P. A.

4757. Reduced Scale Studies in Armour Penetration. L. Thompson. *Physics,* 3. *pp.* 155–158, *Sept.,* 1932.—The attack of armour by competent projectiles involves a punching cycle of very short duration and extreme reactions. The characteristic results, with respect to the essential properties in the design of ship protection, have been investigated by means of simple dimensional forms, and a generalisation has been made by reference to a penetration coefficient. The latter is a function of the penetration number (ratio of plate thickness to projectile diameter) and the obliquity of impact. A similar treatment of the absorption problem is outlined, and the special case of thin plate is of note in the implied linear velocity law of reaction. Conditions for extension in scale are stated and also certain convenient ratios for the estimation of the relative limits of non-similar systems. AUTHOR.

4758. Buckling of Curved Rods. A. S. Lokshin. *Phil. Mag.* 14. *pp.* 520–530, *Sept.*, 1932.—The general theory of the buckling of a naturally curved rod is worked out and the following cases dealt with in detail, the conditions of buckling being determined: (*a*) a rod whose axis is the arc of a circle, (*b*) a similar rod on an elastic foundation, and (*c*) the parabolic arch. J. P. A.

4759. Transverse Vibrations. G. Lampariello. *Accad. Lincei, Atti,* 16. *pp.* 102–105, *Aug.*, 1932.—Develops the equations of motion of an elastic rod constrained by an end-on constant pressure. Under certain conditions the condition of equilibrium becomes unstable, the primary frequency of the system is annulled, the period becomes infinite, and in the vibration the system abandons its configuration of equilibrium, never to regain it. A. D.

4760. Damping of a Wave-Disturbance of Constant Frequency. E. Hahnkamm. *Ann. d. Physik,* 14. 6. *pp.* 683–698, *Aug.* 30, 1932.—It is shown that a periodic disturbing oscillation can be brought to rest by means of mass-coupling with a second system. Theory is given, with friction neglected, to show how the constants may be calculated and how they depend upon the coupling mass, the characteristic frequency and the strength of the coupling. The calculations are only true for a disturbance of constant or nearly constant frequency. H. M. B.

4761. Dissipation of Energy in a Vibrating Bar. A. L. Kimball. *Congrès International d'Électricité, Paris, Sect.* 12. *Comm. No.* 6C2. [11 *pp.*], 1932.—Describes an arrangement whereby a powerful heterodyne oscillator generates longitudinal oscillations in a stout metal bar through electromagnets placed at either end. The dissipation of energy in the bar may be measured thermally, or preferably electromagnetically by the aid of a "potential" coil placed at one end of the bar. Experiment indicates that the dissipation of energy is independent of the frequency of the cycle. J. P. A.

4762. Mechanics of Isotropic Media. K. Hohenemser and W. Prager. *Zeits. f. angew. Math. u. Mechanik,* 12. *pp.* 216–226, *Aug.*, 1932.—The theory of elasticity and of the motion of viscous fluids may be extended to the irregular phenomena of slip and turbulence by including in the general equations terms depending on the mean velocities of the irregular motions. The distinction between solid and fluid is carefully defined, and a general theory developed on these lines. In the part of the theory which connects viscous and non-viscous fluids, certain special cases are shown to represent the behaviour of plastic solids. J. P. A.

4763. States in Kinetic Equilibrium. V. V. Narliker. *Phil. Mag.* 14. *pp.* 431–432, *Sept.*, 1932.—A theorem showing that, under certain conditions, if the kinetic potential of a dynamical system is a minimum, so also is the total energy, but not conversely. G. C. McV.

4764. Elementary Theory of the Gyroscope. P. L. Tea. *Frank. Inst., J.* 214. *pp.* 299–325, *Sept.*, 1932.—In a theoretical treatment the motion of each particle of the gyro disc is followed and its contribution to the overall effect studied. Two sets of conditions are taken, (*a*) intersecting and mutually perpendicular axes of precession of torque, and of the axle of the rotating disc, considering only small variations from the mutually perpendicular position; and (*b*) the axle of the gyro does not move far from the precession axis. The point of intersection of the axes and axle is fixed in space. Seven cases are considered: (1) addition of uniform displacements, and of uniform displacements together with that due to a constant force; under (*a*), (2) uniform precession about an axis fixed in space; (3) sudden removal of the torque from a free gyro, or the motion produced by an impulse; (4) forced uniform precession about a fixed axis in space on a free gyro; (5) nutation produced by suddenly applying a torque to a free gyro; (6) torque gradually applied; and under (*b*), (7) gyro pendulum; top. R. S. R.

4765. Crystal Structure of Calcium Chromate (Anhydrous, Monohydrate and Dihydrate). J. H. Clouse. *Zeits. f. Krist.* 83. *pp.* 161–171, *Aug.*, 1932. *In English.*—$CaCrO_4$ has a tetragonal unit cell, with $a = 7 \cdot 25$, $b = 6 \cdot 34$Å., $c/a = 0 \cdot 875$, space group D_{4h}^{19}, $u = 0 \cdot 17$ and $v = 0 \cdot 34$. Cr has four O neighbours arranged tetrahedrally at a distance of 1·64 Å. Ca has eight O atoms at a distance of 2·45 Å. The hydrates have orthorhombic cells containing eight molecules, that of the monohydrate with $a = 7 \cdot 99$, $b = 12 \cdot 77$, $c = 8 \cdot 11$ Å. (probable space-group V_h^{15}), and that of the dihydrate with $a = 16 \cdot 02$, $b = 11 \cdot 39$, $c = 5 \cdot 60$ Å., and the probable space-group V_h^{11}. F. I. G. R.

4766. Crystal Structure of Lead Chloride. H. Braekken. *Zeits. f. Krist.* 83. *pp.* 222–226, *Aug.*, 1932.—Each Pb atom is surrounded by nine Cl atoms which form a species of double octahedron, built up of two distorted octahedra having a common side, in which the Pb atom is placed. F. I. G. R.

4767. Crystal Structure of Potassium and Rubidium Dithionates. G. Hägg. *Zeits. f. Krist.* 83. *pp.* 265–273, *Aug.*, 1932.—These crystallise in the hexagonal system and form isomorphous crystals of the space group D_3^2 with three molecules in the unit cell. For $K_2S_2O_6$, $a = 9 \cdot 756$ Å. and $c = 6 \cdot 274$ Å., the axial ratio being 0·6434 and the theoretical density 2·30; for $Rb_2S_2O_6$, $a = 10 \cdot 144$ Å. and $c = 6 \cdot 409$ Å., the axial ratio being 0·6318 and the theoretical density 2·89. According to Wyckoff's nomenclature, the six metallic atoms probably lie in (*g*) or in (*e*) + (*f*), the six S atoms in (*c*) + (*d*) + (*d*), and the eighteen O atoms in (*g*) + (*g*) + (*g*). The three S_2O_6 radicals of the unit cell are not structurally equivalent, but all possess a trigonal symmetry-axis. The structure proposed for these salts by Huggins and Frank cannot be accepted. T. H. P.

4768. Crystal Structure of Caesium Dithionate. G. Hägg. *Zeits. f. phys.Chem.* 18. *Abt.B.* 4–5. *pp.* 327–342, *Aug.*, 1932.—From Laue rotation and powder photographs taken with CrK-radiation it is deduced that the unit hexagonal cell has dimensions $a = 6 \cdot 326$ and $c = 11 \cdot 535$ Å., density 3·49 and contain two molecules of $Cs_2S_2O_6$. In the dithionate radical the six O atoms lie at the corners of two equilateral triangles having a common trigonal axis on which lie the two S atoms. W. H. Ge.

4769. Crystal Structure of Double Salts with Different Anions. H. Seifert. *Zeits. f. Krist.* 83. *pp.* 274–300, *Aug.*, 1932.—Double salts

with the same (or isomorphous) or different anions appear to have different crystal structures. As prototype of the second class, the humite-chondrodite group may be taken, with a layer structure of the two components on a singular structure plane. Assumptions and consequences involved in the view that this layer structure represents a molecular uniform growth of the components, are discussed. For known cases, the available data agree with this view. Macro-crystallographic regular growths of questionable systems are frequent in the mineral kingdom. The possibilities of verifying such growths experimentally are limited from various reasons, and a negative experimental result does not necessarily disprove the layer-structure hypothesis. The various theoretical possibilities of layer-structure are considered by comparison of the symmetry of components and double salt, special interest attaching to the products obtained by combination, with enhanced symmetry, of whorled and cubic (pseudo-cubic) crystals. Basic salts are not always of layer structure, and various transition stages up to crystals of typically zeolithic character occur.
T. H. P.

4770. Crystal Structure of Osmiridium. O. E. Swjaginzeff and B. K. Brunowski. *Zeits. f. Krist.* 83. *pp.* 172–192, *Aug.*, 1932.—A full description of this product is given and its X-ray investigation is discussed. Osmiridium of varying origin has one and the same crystal structure, that of pure osmium, and the ratio c/a remains, in general, constant. Osmiridium is taken to be a solid solution of iridium (plus platinum) and osmium. F. I. G. R.

4771. Crystal Structure of Copper-Tin Phases. O. Carlsson and G. Hägg. *Zeits. f. Krist.* 83. *pp.* 308–317, *Aug.*, 1932.—The ϵ-phase is rhombic, the elementary cell containing 32 atoms. The axial lengths (tin phase permitting) are, $a = 5\cdot510$, $b = 38\cdot18$, $c = 4\cdot319$ Å. The η-phase is hexagonal, with $a = 20\cdot95$ and $c = 25\cdot43$ Å., and is related to the structure of NiAs. The so-called γ'-phase (homogeneous for about 22 % Sn at 600° C) is hexagonal with $a = 7\cdot316$ and $c = 7\cdot854$ Å. The elementary cell contains 26 atoms, and the structure can be derived from a cubic space-centred lattice. F. I. G. R.

4772. Crystal Structure of Black Nickel. H. Kersten and J. Maas. *Physics*, 3. *pp.* 137–138, *Sept.*, 1932.—This paper shows by means of X-ray diffraction analysis that electrodeposited black nickel has an amorphous structure which changes to a crystalline structure when the deposit is heated. AUTHORS.

4773. Lattice Constant of Titanium Carbide. M. v. Schwarz and O. Summa. *Zeits. f. Elektrochem.* 38. *pp.* 743–744, *Sept.*, 1932.—Titanium carbide forms cubic crystals of the rock-salt type and has the lattice constant $a = 4\cdot311$ Å.; van Arkel (*Physica*, 4. pp. 286–301, 1924) found 4·29 and Becker and Ebert [see Abstract 1319 (1925)] 4·60 Å. T. H. P.

4774. Application of Statistical Methods to Ionic Lattices. W. Lenz. *Zeits. f. Physik*, 77. 11–12. *pp.* 713–721, *Sept.* 3, 1932.—For crystal lattices containing a large number of electrons, statistical methods are of practical value. The case where electron density is too small must be excluded. Otherwise, by means of a variations-problem, an equation for the energy is derived which can be dealt with so as to obtain reasonably good values for the usual constants. [See also following Abstract.]
F. I. G. R.

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4775. Partition of Ionic Charge, and Lattice Constant of Rubidium Bromide by Statistical Methods. H. Jensen. *Zeits. f. Physik.* 77. 11–12. *pp.* 722–745, *Sept.* 3, 1932.—The analysis is based on the Fermi statistics [compare preceding Abstract], with the help of the Ritz method. It appears that the repulsive forces in polar molecules and crystals arise chiefly from the increase in kinetic energy of the molecular "Fermi-gas" according to Pauli's principle. As an example of the method, the lattice constant for RbBr, neglecting polarisation, comes out to be 3·8 Å, compared with the experimental value of 3·42 Å. F. I. G. R.

4776. Method for Deducing Accurate Values of Lattice Spacing. A. J. Bradley and A. H. Jay. *Phys. Soc. Proc.* 44. *pp.* 563–579, *Sept.* 1, 1932.—The method described has two essential processes, the calibration process and the extrapolation process. The calibration process eliminates errors due to film shrinkage. Errors due to absorption by the specimen and eccentricity of the specimen are eliminated by the extrapolation process. In this, the values of the lattice spacing obtained from the different lines on the film are plotted against the values of $\cos^2 \theta$, and the true value of the lattice spacing is then obtained by an almost linear extrapolation to $\cos^2 \theta = 0$. Results are given for the lattice spacing of iron taken in different cameras with specimens of different diameters. They are consistent to 1 part in 15,000, the mean value being 2·8605. A specimen of electrolytic nickel (3·5162 Å.) was found to give a different value from a specimen of Mond nickel which had been degassed (3·5170 Å.) W. E. P.

4777. Influence of Divergence, Thickness of Specimen and Depth of Impression in the Determination of Lattice Dimensions by the Debye-Scherrer Method. F. Lihl. *Zeits. f. Krist.* 83. *pp.* 193–221, *Aug.*, 1932.—Detailed experimental treatment of the matters indicated in the title, and the influence of screens, camera-radius and instrumental factors. The aim is to deduce from observable data the depth of impression into the preparation of the primary X-ray beam. F. I. G. R.

4778. X-Ray Investigation of Polyoxymethylenes of High Molecular Weight. E. Sauter. *Zeits. f. phys. Chem.* 18. *Abt.B.* 6. *pp.* 417–435, *Sept.*, 1932.—On the basis of rotation and X-ray goniometric measurements on β-polyoxymethylene crystals earlier results of Mie and Hengstenberg [see Abstract 249 (1928), and *Helv. Chim. Acta*, 11. p. 300, 1928] are confirmed, in particular Hengstenberg's data for the unit cell of the macro-molecular lattice of the high molecular-weight polyoxymethylenes. The space-groups are most probably C_3^{2-3}. A γ-polyoxymethylene with average degree of polymerisation 100 has been subjected to X-ray examination. Ott's view that the degree of polymerisation may be determined by X-ray study is considered erroneous. Polyoxymethylene glass represents a new modification with a different macro-molecular lattice. T. H. P.

4779. X-Ray Investigation of the Colour Dimorphism of Stilbene Derivatives. E. Hertel and K. Schneider. *Zeits. f. phys. Chem.* 18. *Abt.B.* 6. *pp.* 436–440, *Sept.*, 1932.—The stable red modification (I) of p-cyano-o-nitro-p′-methoxystilbene forms triclinic crystals: $\alpha = 98°\ 6'$, $\beta = 106°\ 20'$, $\gamma = 75°\ 40'$; $a = 8·50$, $b = 7·45$, $c = 13·35$ Å.; number of molecules per unit cell, 2. This modification represents a unimolecular compound without dipole association. The metastable modification (II) of the same compound forms rhombic crystals: $a = 14·2$, $b = 27·8$,

$c = 7{\cdot}6$ Å., with 8 molecules in the unit cell; translation group Γ_0', space group V_h^{19}, V^6 or C_{2v}''. Dipole association at the methoxy groups of two molecules is indicated in this case. T. H. P.

4780. X-Ray Method of Determining the Sizes of Sub-Microscopic Crystals. G. H. Cameron. *Physics*, 2. *pp*. 57–69, *Aug*., 1932.—A brief critical summary of the principal contributions published on the theory of the subject is presented, followed by the report of a series of experiments designed to test the methods which have been proposed. It is concluded that while relative measurements can be made with sufficient accuracy, absolute values cannot be relied on as yet. The results emphasise the necessity for careful attention to such details as the construction of the camera, the preparation of the sample and the characteristics of the X-ray film and of the microphotometer. AUTHOR.

4781. Crystal Size of Forms of Carbon. U. Hofmann and D. Wilm. *Zeits. f. phys. Chem.* 18. *Abt.B.* 6. *pp*. 401–416, *Sept*., 1932.—The size of the crystals in various forms of carbon of scientific or industrial interest were determined from the breadth of the X-ray spectral lines by the method of Laue and Brill. In the technical activated carbon with the smallest crystals the graphite lattice was found almost unchanged. The results are in complete disagreement with the work of Krishnamurti on "amorphous carbon." Carbons formed at higher temperatures have larger crystals than those formed under similar conditions at lower temperatures. Larger crystals were obtained from carbide than from the vapour phase at the same temperature. The crystal size of active carbon is extraordinarily small, of the order of the larger organic molecules, a fact of special interest in considering its absorption. The measurements of absorbing area, made by measuring the absorption, agree with the calculations based on the crystal size as deduced from the X-ray measurements. W. H. GE.

4782. Slipping and Hardening of Single Crystals of Zinc. M. Straumanis. *Zeits. f. Krist.* 83. *pp*. 29–34, *July*, 1932.—A case of pure translation in zinc crystals is described, the direction $[10\bar{1}0]$ agreeing with that found by Mark, Polanyi and Schmid. The application of stress caused a slipping of crystal laminae about $0{\cdot}8\,\mu$ thick. Inside these laminae there was a much slighter secondary slipping. Slipping occurs until a maximum distance of 1600 lattice planes in the $[10\bar{1}0]$ direction when the $(11\bar{2}0)$ face of the undeformed crystal approximates to the inclination of the $(11\bar{2}2)$ face. F. J. W.

4783. Percussion and Pressure-Figures, and Mechanical Twinning in Quartz. A. Schubnikow and K. Zinserling. *Zeits. f. Krist.* 83. *pp*. 243–264, *Aug*., 1932.—Pressure with a steel sphere upon a quartz face causes a twin to form, and this effect is brought into relationship with the symmetry. The percussion and pressure-figures on quartz are compared with those upon glass, and the magnitude of the figures discussed. F. I. G. R.

4784. Kinetics of Crystallisation. F. v. Göler and G. Sachs. *Zeits. f. Physik*, 77. 5–6. *pp*. 281–286, *Aug*. 2, 1932.—The assumption is made that the nuclei formed with constant frequency, in relation to the volume not crystallised, during the crystallisation of supercooled liquids or during the recrystallisation of treated metals, increase with a constant, linear velocity. On the bases of this assumption, the time-course of the crystallisation, the number of granules and their distribution as regards size are calculated. T. H. P.

4785. Rhythmic Crystallisation of Melts. Part I. J. F. J. Dippy. *J. Phys. Chem.* 36. *pp.* 2354–2361, *Aug.*, 1932.—Rhythmic crystallisation of thin films of molten material has been observed with piperonal, terpin hydrate, vanillin, phenyl benzoate, phenanthrene, cinnamic acid, thymol and 3 : 5-dichloro-4-methyldiphenyl. Investigation of the effects of supercooling, the presence of an air interface and the thickness of the film in the case of 3 : 5-dichloro-4-methyldiphenyl shows that these factors exert a controlling influence on the appearance of rhythmic crystallisation. With the aid of an epidiascope, the details of the rhythmic growth of crystals of 3 : 5-dichloro-4-methyldiphenyl, salol and piperonal have been observed on a lantern screen. Suitable modification and amplification of Vorländer and Ernst's theory (*Zeits. f. phys. Chem.* 93. p. 521, 1919) furnish a satisfactory explanation of the phenomenon and of its governing factors. T. H. P.

4786. Growth of Metal Crystals in Metal Vapour. Part II. M. Straumanis. *Zeits. f. phys. Chem.* 19. *Abt.B.* 1. *pp.* 63–75, *Sept.*, 1932.—In order to confirm the theory of homopolar crystal growth, zinc was sublimed at different pressures of hydrogen and at different temperatures. At pressures of 20 mm. of hydrogen large hexagonal crystals of zinc were obtained. At a pressure of 4 mm. prismatic crystals were obtained. The sublimation was carried out at temperatures ranging from 310° to 475° C. The crystals were observed and measured by a special microscope-goniometer. [For Part I see Abstract 252 (1932).] F. J. B.

4787. Closest Spherical Packing of Higher Order. E. K. Broch. *Zeits. f. Physik*, 78. 3–4. *pp.* 257–270, *Sept.* 21, 1932.—X-ray photographs of elements show lines which may be attributed to closest packing of a higher (*n*th) order, where *n* is the number of layers superposed upon each other periodically in a direction perpendicular thereto. A table comprising possible space groups is given for the trigonal and hexagonal systems. F. I. G. R.

4788. Structural Formulæ for the Partitioning of Planes. F. Haag. *Zeits. f. Krist.* 83. *pp.* 301–307, *Aug.*, 1932.—An application of Euler's equation, where the number of edges is very large, and consequently the factor 2 is omitted. The results are purely formal. An Appendix deals with the filling of space by a number of polyhedra, and consequently an additional term P, denoting how many there are, enters into the original equation. F. I. G. R.

4789. Paracrystalline and Crystalline Anisal-α-Benzolazo-α_1-Naphthylamine. F. Rinne. *Zeits. f. Krist.* 83. *pp.* 227–242, *Aug.*, 1932.—The preparation of the paracrystalline and crystalline forms from melts and solutions is described in great detail. The results of polarisation and X-ray examinations of the various modifications are given and compared, and the isomerism of the crystalline phases is discussed. The hardening of the liquid crystals by supercooling, their transformation and structural orientation are also described. C. B. A.

4790. Structure of Atoms and Molecules. L. and E. Bloch. *Congrès International d'Électricité, Paris, Sect.* 1. *Rapport No.* 23. [42 *pp.*], 1932.—In the first section, the structure of the atom as related to spectral

theory is given. The various rules and laws of line spectra are then considered in turn. Band spectra are similarly treated in the second part.
F. S.

4791. Physical Constants of Methyl Fluoride and Atomic Weight of Fluorine. W. Cawood and H. S. Patterson. *Chem. Soc., J. pp.* 2180–2188, *Aug.*, 1932.—In consequence of the criticisms by Moles of the authors' earlier work on CH_3F, redeterminations have been made of (1) the critical constants, using CH_3F prepared both by heating tetramethylammonium fluoride and by the interaction of potassium methyl sulphate and KF, and (2) the compressibility of CH_3F made by the latter method. [See Abstract 1506 (1932).] The lack of justification for the statement that pure CH_3F is not obtained by the first of the above methods is shown by the identity of the critical data found for the two preparations: critical temperature 44·55° C., pressure 58·0 ± 0·2 atmospheres, volume 3·33 c.c. per gm. The compressibility $(1 + \lambda)$ at 21° C. is 1·0087 and at 0° C. 1·0114, which somewhat exceeds van Laar's calculated figure 1·0094, but the difference is decreased by the new value found for the critical pressure. In deducing the molecular weight of CH_3F from the microbalance measurements, the measured value of the compressibility is applied to each of the pressure ratios of O_2 to CH_3F. This gives 34·044 and 34·043 as the molecular weight, so that, if $C = 12·010$, $F = 19·011$. This value, in conjunction with those found by McAdam and Smith and by Smith and Haagen, *viz.*, 19·009 and 19·005, indicate that the true value lies between 19·005 and 19·010. If this is so, F must contain a higher isotope in appreciable quantity.
T. H. P.

4792. Atomic Weight of Osmium. R. Gilchrist. *Bureau of Standards, J. of Research*, 9. *pp.* 279–290, *Sept.*, 1932.—A method for the preparation of pure osmium is described. The value of the atomic weight of osmium is calculated from the average percentage of osmium found in carefully prepared samples of ammonium chloroosmate and of ammonium bromoosmate. The value obtained from the ratio $(NH_4)_2OsCl_6 : Os$ is 191·53, and from the ratio $(NH_4)OsBr_6 : Os$ is 191·57, based upon values for nitrogen, hydrogen, chlorine and bromine given in the International Table of Atomic Weights for 1932. The weighted average value is 191·55. The densities of ammonium chloroosmate and of ammonium bromoosmate at 25° C. were found to be 2·93 gm./cm.^{3} and 4·09 gm./cm.^{3} respectively.
AUTHOR.

4793. Atomic Weight of Sodium. Part I. C. R. Johnson. *J. Phys. Chem.* 36. *pp.* 1942–1949, *July*, 1932.—Reference is made to a new titration method for the accurate measurement of chemical atomic mass ratios. In the present work it is shown that if AgCl precipitated from HNO_3 solution is repeatedly washed with pure water, the washing solution eventually contains excess chloride over silver, an excess of silver remaining with the precipitate. The author shows that the prevalent notion concerning the high accuracy of nephelometrically determined atomic mass ratios is fallacious.
J. K.

4794. Atomic Weight of Potassium. Part I. C. R. Johnson and G. W. Low, Jr. *J. Phys. Chem.* 36. *pp.* 2390–2394, *Sept.*, 1932.—Describes a method in which the potentiometer may be substituted for the nephelometer in finding the end-point of certain precise titrations.

The scope of the method is shown by a record of potentiometric and nephelometric analyses of KNO_3–HNO_3 solutions saturated with AgCl.
G. E. A.

4795. Molecular Weights in Different States of Aggregation. G. Antonoff. *J. Phys. Chem.* 36. *pp.* 2406–2436, *Sept.*, 1932.—A connected account of the author's theory which is based on the assumption that as the phases in equilibrium exert the same pressure on one another they are equimolecular, and therefore the number of molecules contained in a given volume of a substance whether vapour or liquid is the same. Consequently if M_l and M_v are the molecular weights in the liquid and vapour states and d_l, d_v the corresponding densities, $M_l/M_v = d_l/d_v = X$, the "factor of association." The theory is considered proved by the fact that if various physical properties, *e.g.*, $d_l - d_v (= d)$, surface tension, latent heat of vaporisation or viscosity be plotted against temperature, discontinuities are observed, the relation being expressible by a series of equations of the form $Ae^{\lambda d} = T + B$, T being the difference between the critical and actual temperatures, A, B and λ constants, successive curves intersecting at the discontinuities. The method is applied to hexamethylene (crit. temp. 280° C.) for which, by using five different sets of values of these constants, close agreement with the actual *d*/temperature curve is obtained. It is supposed that at each discontinuity there is only one kind of molecule consisting of a whole number of the molecules at the next higher discontinuity. Thus for hexamethylene there are molecules consisting of 576, 96, 24 and $4C_6H_{12}$ at respectively 55°, 115°, 175° and 262° C., X varying from 1084 at 40° to 2·4 at 274° C. Other examples are given. [See Abstract 1868 (1926).] C. A. S.

4796. Van der Waals Forces Between Tetrahalide Molecules. J. H. Hildebrand and J. M. Carter. *Am. Chem. Soc., J.* **54.** *pp.* 3592–3603, *Sept.*, 1932.—The compounds studied are carbon, silicon, titanium and tin tetrachlorides, and tin and silicon tetrabromides. Measurements of the expansion on mixing have been made for 7 binary mixtures, and the thermal pressure coefficients ($\partial p/\partial T$ at constant volume) have been determined for the separate liquids and the 7 mixtures. The calculated values of the van der Waals constant *a*, in (litres)^2 × atmospheres per mol. for the liquids given above, are 31·21, 34·00, 41·90, 44·84, 53·36 and 64·79, respectively; *a* is approximately proportional to the interhalogen distance in the molecule. The values calculated from the binary mixtures are in fair agreement with those observed experimentally. Stannic chloride is somewhat anomalous, and although probably of tetrahedral structure is possibly more ionic in character than the other compounds studied. The compressibilities of the pure liquids at 25° are calculated. H. F. G.

4797. Simple Device for Demonstrating Brownian Movement in Gases. D. A. Wells and W. Lange. *Rev. Sci. Instruments,* 3. *pp.* 474–475, *Sept.*, 1932.—Describes a convenient method of observing the Brownian movement of smoke particles in air, using an ordinary microscope. J. H. A.

4798. Reflection of Thallium, Lead and Antimony Atoms from Sodium Chloride Crystals. J. M. B. Kellogg. *Phys. Rev.* 41. *pp.* 635–640, *Sept.* 1, 1932.—The reflection of atomic beams of Tl, Pb, and Sb from a freshly cleaved surface of a crystal of sodium chloride has been studied by means of a deposit method. The beams of Tl and Pb are in part scattered at random and in part reflected so that the angle of reflection is equal to the angle of incidence. Sb incident at a large grazing angle is reflected so that the reflected beam makes a larger angle with the normal than the incident beam. It is suggested that the direction of this deviation may be qualitatively accounted for on the basis of the ideas of Duane and of Williams on the interchange of momentum between the incident particle and the crystal. AUTHOR.

4799. Determination of Planck's Constant as a Quantitative Lecture Experiment. R. Suhrmann. *Phys. Zeits.* 33. *pp.* 579, *Aug.* 1, 1932.—The variation of the maximum e.m.f., v, developed by a photoelectric cell irradiated successively by the yellow and blue lines of the mercury-vapour lamp is measured by a simple potentiometric compensation method. Planck's constant is calculated from the relation $h = e_0(v_1 - v_2)/(\nu_1 - \nu_2)10^7$. H. F. G.

4800. Angular Momentum and Virial Equations of the Dirac Electron. S. Gupta. *Indian Phys. Math. J.* 3. *pp.* 105–113, *June*, 1932.—The momentum equation shows that the correspondence between the spinning electron of Dirac and the electron of the classical theory is perfect in the case of the Lorentz electron when the velocity of the Dirac electron is taken to be $\dot{x}$, where x is a coordinate. But when the complicated constitution of this velocity is taken into account the momentum equation somewhat resembles that given by Frenkel for an electron with electric and magnetic moments. In the present paper the author examines the angular momentum as well as the virial equations, given by him [see Abstract 2973 (1931)], to see how far the correspondence with Frenkel's electron can be maintained, so far as these two equations are concerned. It is found that Dirac's electron in general yields some more extra terms which cannot be easily expressed in terms of classical quantities and when under suitable conditions these vanish a virial equation of exactly the form given by Frenkel is obtained. H. L. B.

4801. Dirac Electron in Simple Fields. M. S. Plesset. *Phys. Rev.* 41. *pp.* 278–290, *Aug.* 1, 1932.—The relativity wave equations for the Dirac electron are transformed in a simple manner into a symmetric canonical form. This canonical form makes readily possible the investigation of the characteristics of the solutions of these relativity equations for simple potential fields. If the potential is a polynomial of any degree in x, a continuous energy spectrum characterises the solutions. If the potential is a polynomial of any degree in $1/x$, the solutions possess a continuous energy spectrum when the energy is numerically greater than the rest-energy of the electron; values of the energy numerically less than the rest-energy are barred. When the potential is a polynomial of any degree in r, all values of the energy are allowed. For potentials which are polynomials in $1/r$ of degree higher than the first, the energy spectrum is again continuous. The quantisation arising from the Coulomb potential is an exceptional case. AUTHOR.

4802. Analogy between the Dirac Electron and the Electromagnetic Wave. L. de Broglie. *Comptes Rendus*, 195. *pp.* 536–537, *Sept.* 19, 1932.—Vectors representing respectively the densities of the magnetic and electric moments of the Dirac magnetic electron are shown to be the analogues of the magnetic and electric fields of an electromagnetic wave. J. S. G. T.

4803. Dirac's New Relativistic Quantum Mechanics. T. Sakai. *Phys. Math. Soc. Japan, Proc.* 14. *pp.* 355–362, *July,* 1932.—The method of Dirac's new theory [see Abstract 3581 (1932)] in which the radiational field is left to take charge of the interaction energy between the particles, is applied to the problem of two particles in three dimensions. The radiational field is represented by the vector potential, the scalar potential being expressly assumed absent. The probability amplitude is expanded in powers of $1/c$, instead of in powers of e as in Dirac's one-dimensional example. For the interaction energy between the particles the expression $\frac{e_1e_2}{2m_1m_2c^2}\left\{\frac{p(1)p(2)}{r}+\frac{(p(1)r)(p(2)r)}{r^3}\right\}$ is obtained, which is exactly the result given by Darwin on the classical theory for the contribution to the interaction energy due to magnetic and retardation effects between the two particles. No term corresponding to Coulombian attraction is obtained. (It should especially be noted that the calculation assumes no scalar potential). W. S. S.

4804. Dirac's Proposed Quantum Electrodynamics and its Formal Connection with the Heisenberg–Pauli Theory. L. Rosenfeld. *Zeits. f. Physik,* 76. 11–12. *pp.* 729–734, *July* 12, 1932.—The author shows that a quantum electrodynamics developed by the method recently proposed by Dirac [see Abstract 3581 (1932)] is formally equivalent with the Heisenberg–Pauli quantum theory of the electromagnetic field. The difficulties associated with the existence of singularities of the electromagnetic field are not therefore likely to be solved by Dirac's new method. W. S. S.

4805. Born's Collision Theory. G. Wick. *N. Cimento,* 9. *pp.* 231–235, *July,* 1932.—In Born's fundamental wave-mechanical paper on collisions [see Abstract 43 (1927)] a method of successive approximations was given for calculating the probabilities of deflection, excitation, etc. The present paper shows by means of specific examples that the second approximation term does not become small compared with the first when the incident particle has a very high velocity. J. H. A.

4806. Quantum Mechanics of Collision Processes. Part II. P. M. Morse. *Rev. Modern Physics,* 4. *pp.* 577–634, *July,* 1932.—The ideas developed in the first part of the survey [see Condon, Abstract 2965 (1931)] are applied to the fundamental collision processes encountered in electric discharge in gases and in chemical dynamics: elastic scattering, excitation and ionisation by impact, and the collisions of the second kind. It is shown that there are two methods of attacking the problem analytically. In the one method the whole process is considered to be in equilibrium; in the other the process is regarded as non-stationary. The sub-headings are: scattering from a centrally-symmetric potential field (exact solutions); approximate solutions; scattering of electrons by atoms; and collision of atom with atom. H. L. B.

4807. Interaction of Two Electrons. H. Bethe and E. Fermi. *Zeits. f. Physik,* 77. 5–6. *pp.* 296–306, *Aug.* 2, 1932.—The connection between the formulæ of Breit and Møller [see Abstracts 2735 (1932) and 3719 (1931)] and quantum electrodynamics is discussed. It is shown that Breit's formula can be derived from Møller's formula and quantum electrodynamics, and that Møller's formula follows from the latter. J. E. K.

4808. Periodic Orbits in a Field of Force Defined by a Certain Potential. M. A. Higab. *Phil. Mag.* 14. *pp.* 298–304, *Aug.*, 1932.—The analysis developed in a previous paper [see Abstract 1751 (1932)] for motion in two dimensions is extended to motion in three dimensions, the following cases being discussed: (1) motion on a right circular cone, (2) motion on a sphere, and (3) general motion. In each case, conditions for the existence of periodic orbits in a field of force of potential, V, defined by $V = \mu\int F(r)dr + (\lambda/r^2)\int f(\theta)d\theta$ are deduced. J. S. G. T.

4809. Three-Dimensional Periodic Orbits in the Field of a Non-Neutral Atom. M. A. El-Sherbini. *Phil. Mag.* 14. *pp.* 304–310, *Aug.*, 1932.—Discusses mathematically the three-dimensional motion of a particle in the field of a non-neutral atom. The conditions for the existence of periodic orbits are found for a relatively weak doublet-strength. It is shown that these conditions can be satisfied and that an infinite number of periodic orbits exist. A. H.

4810. Sum Rules for Atomic Transition Probabilities. J. P. Vinti. *Phys. Rev.* 41. *pp.* 432–442, *Aug.* 15, 1932.—Some new sum rules for atomic transition probabilities are developed; they are similar to the well-known rule of Kuhn, Reiche and Thomas. They give, if unpolarised light is incident on any gaseous element in any given discrete energy level, the total absorption, excitation plus ionisation, with various types of frequency weighting. The results are similar to those of Dirac and Harding [see Abstract 3423 (1932)], but are more general in that they apply to any discrete state of any atom, rather than to the ground state of hydrogen only. The method differs from that of Dirac and Harding. AUTHOR.

4811. Relativistic Thomas-Fermi Atom. M. S. Vallarta and N. Rosen. *Phys. Rev.* 41. *pp.* 708–712, *Sept.* 15, 1932.—The Thomas–Fermi equation determining the inner atomic potential and the charge distribution is generalised to take care of the relativistic change of mass with velocity. The relativistic equation is then solved numerically by means of a first order perturbation method and with the help of the differential analyser. The solution is applied to the case of mercury and it is shown that while the atomic potential changes only slightly, the charge density is appreciably increased in the immediate vicinity of the nucleus and slightly decreased at larger distances. AUTHORS.

4812. Wentzel–Brillouin–Kramers Method of Solving the Wave Equation. J. L. Dunham. *Phys. Rev.* 41. *pp.* 713–720, *Sept.* 15, 1932.—A more general treatment than has been available of the Wentzel–Brillouin–Kramers method of solving Schrödinger's equation for one degree of freedom is given. Wentzel's original energy-level condition is shown to be an asymptotic expression, good for large masses and large values of the quantum number. The connection between this method and that of Young is discussed. Finally the formulæ are written in a form convenient for application to the calculation of energy levels from actual potential functions. [See following Abstract.] AUTHOR.

4813. Energy Levels of a Rotating Vibrator. J. L. Dunham. *Phys. Rev.* 41. *pp.* 721–730, *Sept.* 15, 1932.—The energy levels of a rotating vibrator are calculated in considerable detail by means of the Wentzel–Brillouin–Kramers method [see preceding Abstract]. The new terms determined are $\omega_e z$ and a set of correction terms which appear in the earlier members of the equation. These correction terms enter in such a way that ω_e is not exactly the coefficient of $(v + \frac{1}{2})$; B_e is not exactly the coefficient of $K(K + 1)$, etc. However, the differences are small and are detectable only in the case of light molecules. The correction terms are of the magnitude of B_e^2/ω_e^2. Formulæ for the effect of the correction terms on isotope shifts are given, and for the calculation of the correction terms themselves. Also a method is given for obtaining actual potential functions from band spectrum data, based on Morse's potential function. Finally the numerical magnitude of the correction terms for several states of H_2 and for NaH is discussed. AUTHOR.

4814. Non-Adiabatic Crossing of Energy Levels. C. Zener. *Roy. Soc., Proc.* 137. *pp.* 696–702, *Sept.* 1, 1932.—When a single parameter of an atomic system, such as the distance apart of the nuclei in a molecule, is varied adiabatically, it may happen that two eigenenergies of the system first approach each other and then recede, the corresponding eigenfunctions having exchanged their characters, *e.g.*, one state originally polar may become homopolar, the other state undergoing the reverse change. If the parameter is varied with a non-vanishingly small velocity a quantum transition of the system from one state to the other may occur, so that the original character of the system is preserved. The present work gives a rigorous calculation of the probability P that the system will make such a quantum jump from one state to the other, and obtains P as a function of the closest distance between the adiabatic eigenenergies of the two states, and of the speed with which the variation of the parameter takes place. W. S. S.

4815. Eigenvalues of an Asymmetrical Rotator. B. S. Ray. *Zeits. f. Physik*, 78. 1–2. *pp.* 74–91, *Sept.* 8, 1932.—Shows, by matrix-mechanics, the dependence of the eigenvalues on the moments of inertia of an asymmetrical rotator. Solves numerically (for $j = 5$, 6, 7 and 8) the special case when the reciprocal of the moment of inertia about one axis is equal to the arithmetic mean of the reciprocals of the moments about the other two axes. Also shows how interpolation for a general case can be carried out, given a knowledge of the eigenvalues for the asymmetrical case and for the more easily soluble case of small asymmetry. The interpolation is less accurate for higher j-values than for lower. G. G. S.

4816. Wave Mechanics Theory of the Harmonic Oscillator. C. W. Oseen. *Arkiv f. Mat., Astron., och Fysik. Stockholm*, 23*A*. 2. [8 *pp.*], 1932. *In German.*—In the usual wave mechanics theory of the harmonic oscillator the potential energy in the form $\frac{1}{2}mk^2x^2$ is always positive and increases proportionally to the square of the distance, up to infinity. The eigenenergy values take the form $E = h\nu(n + \frac{1}{2})$. It is now shown that if the potential energy has the above form up to any arbitrarily large value of $|x|$ but beyond that decreases to zero (thus in practice the physical conditions are scarcely modified), then the modified oscillator yields no positive eigenenergies whatever. The theory must therefore be modified and this is done by assuming for the potential energy the expression $\frac{1}{2}mk^2(x^2 - x_0^2)$ for $|x| \leq x_0$ and the value zero for $|x| > x_0$, where x_0 is such that $\frac{1}{2}mk^2x_0^2$ is very large compared with $h\nu = hk/2\pi$. The theory now leads to the eigenenergies given by $\{- mk^2x_0^2 + h\nu(n + \frac{1}{2})\}$, $n = 0, 1, 2, \ldots$ All these are negative because the calculation shows that n must satisfy the inequality $n + \frac{1}{2} \leq \frac{mk^2x_0^2}{h\nu}$. For positive energies the wave equation is now satisfied for any eigenenergy, *i.e.*, there is a continuous spectrum. Physically this corresponds simply to free electrons incident on the oscillator which are reflected or transmitted. W. S. S

4817. Problems of Perturbations and Self-Consistent Fields. L. Brillouin. *J. de Physique et le Radium*, 3. *pp.* 373–389, *Sept.*, 1932.—It is shown that the problem of perturbations in wave mechanics can be rigorously treated, the final secular equation being derived in determinantal form. Schrödinger's formulæ for the degenerate or non-degenerate forms of the problem are readily obtained therefrom. The equation can also be applied to the study of a large perturbation occurring in a system characterised by very close energy levels. The theory of self-consistent fields is developed directly in a form giving not only a first approximation to the perturbation but also the complete matrix of the residual perturbation. The Hartree and Fock types of self-consistent fields are compared, and the theory developed is applied to the discussion of free electrons in metals. J. S. G. T.

4818. Calculation of Electron Distribution in a Diatomic Molecule by the Thomas–Fermi Method. F. Hund. *Zeits. f. Physik*, 77. 1–2. *pp.* 12–25, *July*, 1932.—With given nuclear separation and given charge the calculation of potentials and electron distribution in a neutral molecule with two equal nuclei consists of the solution of the equation $\Delta u = \gamma u^{3/2}$, where the parameter γ depends on the particular case, and with boundary conditions which do not. The equation is solved for two values of the parameters (cases of $-N_2$ and F_2). The calculation is somewhat tedious, but the results show that the potential represents with a good approximation the sum of two spherically symmetrical functions round each nucleus. J. E.

4819. Electronic Structures of Polyatomic Molecules and Valence. Part III. Quantum Theory of the Double Bond. R. S. Mulliken. *Phys. Rev.* 41. *pp.* 751–758, *Sept.* 15, 1932.—The electronic structure of CH_2 in its probable normal and first excited states is described in terms of molecular orbitals. The formation of C_2H_4 from two excited CH_2 radicals is discussed, and it is shown, with the help of the Slater–Pauling overlapping criterion, to be theoretically obvious, in agreement with experiment, that for the normal state of C_2H_4 the energy is surely considerably lower if the two CH_2 are arranged symmetrically in one plane than if their planes make an angle of 90°. Similar statements apply to the derivatives of C_2H_4. The C=N and N=N double bonds can be treated similarly. The C=C and O=O double bonds are compared. The $(BH_3)=(BH_3)$ bond in B_2H_6 probably resembles the O=O more than the C=C bond. For certain predicted excited states of C_2H_4 and its derivatives, which are probably the upper states of ultra-violet absorption bands of these compounds, it is shown that the energy should be higher for the plane form than for the perp. form (one $CR'R''$ plane rotated through 90°). Hence the plane form should tend to go over spontaneously by rotation into the perp. form (90°) and on to the other plane form (180°) after absorption of suitable ultra-violet light. In this way the observed transformations of *cis* into *trans* isomers or *vice versa* by ultra-violet light may be explained. [For Part II see Abstract 4117 (1932).] AUTHOR.

4820. Extension of the New Einstein Geometry. A. D. Michal and J. L. Botsford. *Nat. Acad. Sci., Proc.* 18. *pp.* 554–562, *Aug.*, 1932.—The general theory is given of an n-dimensional Riemannian space, with a metrical tensor, with which is associated an m-dimensional linear vector space whose connection is assigned. The case $m > n$ is dealt with and its bearing on the special case $m = 5$, $n = 4$ (the Einstein–Mayer "unified field theory") is considered. The paper is entirely mathematical. G. C. McV.

4821. Einsteinian Motion. M. Cimino. *Accad. Lincei, Atti*, 16. *pp.* 120–126, *Aug.*, 1932.—Shows how Levi-Civita's principle of equivalence permits us to determine some laws of Einsteinian motion not only in the space-variety defined by Schwarzschild, but also in ordinary Euclidean space. The present note investigates a law of areas for Einsteinian motion in ordinary Euclidean space, which is found to lead to the laws of cosmic time with the aid of only the rudiments of celestial mechanics. A. D.

4822. Galileo's Mechanical Similitude and the Relativity of Space. L. Laboccetta. *Elettrotecnica*, 19. *pp.* 562–566, *Aug.* 5, *and pp.* 600–607, *Aug.* 15–25, 1932.—Recalling the rise under Galileo and Newton of the theory of mechanical similitude, extended by Maxwell and Gibbs to electrodynamical and thermal phenomena, the signification of the relativity of space is precisely determined, indicating the characters which distinguish geometrical and kinematical space from physical space. In view of the consequences, according to Galileo, of the particular mechanical similitude, it is shown how the general mechanical similitude according to Newton provides means for the absolute definitions of space and of time. Introducing the conception of atomic elementary time θ_1, we have the relation $\theta_1 = \mathrm{TM}^{1/2}$ between the proper periodic times and the molecular weight M of the different substances; from this follow: (*a*) a method for determining the mass of a star from the value of the periodic time of the bodies rotating with reference to it; (*b*) the existence, with optical analogies, of a gravitation-spectrum which reveals the structure of the solar system from which it is emitted; (*c*) the existence of a gravitational effect, an apparent variation of mass, analogous to the Döppler–Fizeau effect in acoustics and optics. Three procedures are indicated, founded on mechanical similitude, for the absolute determination of dimensions giving the measure a statical, a dynamical and a thermodynamical definition. From the similitude extended to the elements of matter down to the molecule, there is deduced from a model of the solar system a new enunciation of Kepler's law, and from the corresponding atomic model there are deduced discontinuities of certain physical quantities, which all vary by quanta. Finally, while there is no character which reveals the size of figures existing in geometrical space, yet on the other hand for every material system effectively existing the physical properties enable us in every case to assign absolute dimensions. A. D.

4823. Unitary Theory. P. Straneo. *Accad. Lincei, Atti*, 16. *pp.* 139–141, *Aug.*, 1932. *Zeits. f. Physik*, 77. 11–12. *pp.* 829–833, *Sept.* 3, 1932.—A further development of the author's theory [see Abstract 4128 (1932)]. The result is that applying to a pseudo-Euclidean quadri-dimensional space a torsion subject to the sole condition of not altering the absolute parallelism or the Euclidety, there is obtained, without more, a continuum able to represent geometrically a universe (space-time with relative matter, electricity and corresponding fields) subject to laws essentially analogous to those of our physics. A. D.

4824. Gravitation and Electricity. Irene E. Viney and G. H. Livens. *Phil. Mag.* 14. *pp.* 243–254, *Aug.*, 1932.—A field theory of gravitation is formulated on the lines of classical electromagnetics, starting from the assumption that every material particle is endowed with a certain amount of "gravity," the analogue of the "charge" of the electrical theory. The development of the theory leads to the conclusions that the inertial mass of a moving body is proportional to the square of its gravitational mass, that this latter mass is negative and that the displacement of the perihelion of mercury is one-sixth of the observed value. G. C. McV.

4825. Radiation in a Gravitational Field. A. Maior. *Phys. Zeits.* 33. *pp.* 683–685, *Sept.* 15, 1932.—The displacement of a mass in a gravitational field is shown, mathematically, to be accompanied by the emission or absorption of radiation. [See also Abstract 427 (1929).] J. S. G. T.

4826. Newtonian Gravitational System and the Expanding Universe. W. R. Mason. *Phil. Mag.* 14. *pp.* 386–400, *Sept.*, 1932.—The hydrodynamical equations of a mass of perfect gas, which is symmetrically distributed around a point and whose density at any point may vary with the time, are established and shown to be invariant under Newtonian (not Lorentz) transformations of Euclidean space. Two static solutions of the equations exist, both of which require an infinite amount of matter in the universe. If, further, an infinite amount of matter exists, not distributed according to the static solutions, there will be a periodic solution in which the density fluctuates between extreme limits at any point. This implies that one part of the medium will approach or recede from other parts and an observer situated at the centre of the distribution will observe an effect analogous to the recession of the nebulæ. The necessary density which corresponds to the observed velocity of recession is calculated to be 10^{-26} gm./cm.^{3}, and the period of an oscillation of the density is 2×10^9 years. G. C. McV.

4827. Expanding Universe. H. P. Robertson. *Science*, 76. *pp.* 221–226, *Sept.* 9, 1932.—A survey of the observational material bearing on the recession of the nebulæ is followed by a discussion of the various types of expanding spherical spaces in which such a phenomenon is predicted by relativity theory. G. C. McV.

4828. World Criterion. V. V. Narliker. *Phil. Mag.* 14. *pp.* 433–436, *Sept.*, 1932.—A criterion is given to distinguish a mass-point from all other mathematically possible singularities. The same criterion shows that during the passage from the Einstein state to another, where all the cosmical matter has broken up into discrete condensations, λ increases from $\frac{1}{R_0^2}$ to $\frac{3}{2}\frac{1}{R_0^2}$. That we observe most of the cosmical matter as discrete condensations is therefore taken as evidence for a tendency in λ to increase in the Einstein state. This is shown mathematically to be equivalent to an initial tendency in the universe to expand. It is thus possible that the genesis of the stellar system was the cause of the expansion of the universe so that the stellar system of our observation may be evidence enough about the expansion of the universe if the interpretation of the red-shift of the spiral nebulæ is controversial. AUTHOR.

METEOROLOGY, GEOPHYSICS AND ASTROPHYSICS.

4829. **Source of Error in Measuring Radiation on a Horizontal Surface. W. E. K. Middleton.** *Gerlands Beitr. z. Geophys.* 37. 1. *pp.* 25–36, 1932. *In English.*—It is shown that measurements of radiation from sun and sky suffer from the fact that most pyranometers, if not all, respond differently to equal amounts of light incident at various angles. A graphical method of comparing the behaviour of several pyranometers is developed, and some experimental results set out. Some remarks on similar errors of photoelectric instruments are included. AUTHOR.

4830. **Visual Range of Lights at Night. M. G. Bennett.** *Roy. Meteorolog. Soc., Trans.* 58. *pp.* 259–267; *Disc.*, 267–270, *July*, 1932.—The author measured in the laboratory the threshold intensity of a point source of white light, for it to be just visible when seen against a background brightness B which was varied over a range of $0{\cdot}25$ to $8{\cdot}5 \times 10^7$ apparent c.p./km.^{2} The threshold intensity k (in c.p./km.^{2}) was found to satisfy $k = 10^{-4}B^{2/3}$. Experiments by Biggs on the visual range of ordinary objects and lights of different candle-power by day, on two occasions of fog, are then discussed, and using the formula for k estimates of the background brightness obtaining in the two cases are made. The relation between the visual range of ordinary objects by day and of lights at night is examined. There is no unique relation between these two types of range (a change in atmospheric conditions may increase one and decrease the other), but some kind of correlation may be expected and experimental results of various workers are plotted which indicate a certain correlation. In the *Discussion*, **Gold** mentioned observations of visibility at sunrise made by investigators at Berlin, who observed a time at which the visibility was a minimum. W. S. S.

4831. **Variations of Atmospheric Absorption. G. Rougier.** *Comptes Rendus,* 195. *pp.* 363–365, *Aug.* 1, 1932.—It is inadmissible to use the mean value of the transmission coefficient of the atmosphere to correct measurements of atmospheric absorption except under certain conditions. It is necessary to determine the value of the coefficient for each night on which measurements are made. Observations of the intensity of the moon's light between October, 1930, and April, 1932, have been corrected on this basis. H. L. B.

4832. **Exploration of Atmospheric Disturbances by Sounding Balloons. J. Bjerknes.** *Geofysiske Publ.* 9. 9. [52 *pp.*], 1932. *In French.*—Thirty-one sounding balloons were sent up from Uccle between 11.30 on Dec. 26, 1928, and 10.55 on Dec. 28, 1928, of which twenty-six were recovered after travelling from 57 to 842 km. and reaching heights of 3150 to 20,030 m. On the morning of Dec. 26th, an intense cyclone crossed the North Sea, followed by a secondary on Dec. 28th. The results are tabulated fully, and with aid of vertical sections of the atmosphere and isothermal and isentropic diagrams, etc., the positions of the cold front, perturbations in the level of the tropopause, and accompanying variations in pressure at various heights are discussed in great detail. A brief account follows of the results with seven balloons sent up during

March 29–30, 1928, when two cyclonic centres, one west of Scotland, the other over Central Europe, were disappearing. C. A. S.

4833. Calculation of the Paths of Two Recurving Low-Pressure Areas. J. M. Angervo. *Gerlands Beitr. z. Geophys.* 37. 1. *pp.* 1–6, 1932.—The actual paths of two recurving storms over the North Sea are compared with the paths deduced theoretically [see Abstracts 63 (1931) and 737 (1932)], and shown to be in moderate agreement therewith. C. A. S.

4834. Variations of Tropospheric Energy Due to Stratospheric Pressure Oscillations. H. Ertel. *Gerlands Beitr. z. Geophys.* 37. 1. *pp.* 7–15, 1932.—The author examines the conclusions drawn by Bergeron and Becker on the variations of tropospheric energy caused by variations of stratospheric pressure. He shows mathematically that the energy accumulated by adiabatic compression in tropospheric air columns ought, if transferred into kinetic energy, to correspond to equivalent velocities of the order of magnitude of 1 — 10 m./sec. The inadmissibility of Becker's calculations regarding isothermal changes is demonstrated. R. S. R.

4835. Wave-Length of Air Waves. B. Haurwitz. *Gerlands Beitr. z. Geophys.* 37. 1. *pp.* 16–24, 1932.—In an earlier paper [see Abstract 1543 (1932)] formulæ were obtained for the wave-length of Helmholtz waves for various temperature gradients at the boundary of two air currents allowing for a vertical decrease of density and compressibility of the atmosphere. When other conditions are constant the wave-length increases as the vertical temperature gradient approaches the adiabatic. For adiabatic changes and adiabatic gradients, which are more general with barotropic movements, the formula obtained is the same as for incompressible fluids. Two series of curves are given from which values can be obtained for the wave-length for temperature gradients of 0·33°/100 m. and 0·67°/100 m. For other gradients the formulæ must be applied if greater accuracy is desired. The effect of changes of humidity is not considered. Examples of a few cases of Helmholtz waves are given and discussed. R. S. R.

4836. Relation Between Pressure and Wind. T. Hesselberg. *Geofysiske Publ.* 9. 8. [35 *pp.*], 1932. *In German.*—The angle of deviation (ϕ) of the air flow and the ratio of velocity (v) to pressure gradient (G) differs for different wind directions. The effects of the frictional resistance of the air are investigated further in the paper. The general equations connecting pressure, wind and acceleration of air flow are stated and applied to the following cases: (1) linear field of motion, (2) field of motion in the neighbourhood of a singular point in the pressure field, (3) air flow in the inner parts of a circular anticyclone or cyclone, and (4) air flow in the neighbourhood of a col in the pressure field, each being propagated without change of form. The variations of ϕ and $v/\alpha G$ in the inner parts of a circular anticyclone and cyclone are shown by curves for certain specified dimensions, and values are tabulated for different regions of each. Similar values are obtained for a trough of low pressure and a ridge of high pressure. Finally the displacement of singular points and lines of the wind field relatively to that of the pressure field are obtained. These theoretical relations are then compared with direct measurements from U.S.A. weather charts for 1927 over the central plains. In individual cases large departures occur in ϕ and $v/\alpha G$ but mean values give good agreement and thus confirm the basis of the theory. The individual departures are explained by the deepening or filling up of depressions, irregular form of the system, assumptions regarding friction, and the effects of turbulence and convection. R. S. R.

4837. Integrators of Wind Run, Wind Direction and Vectorial Wind Displacement over Any Period of Time. W. Grundmann. *Zeits. f. Instrumentenk.* 52. *pp.* 403–407, *Sept.*, 1932.—Two forms of apparatus are described: (1) For the total wind flow the cup anemometer operates a dynamo and the current flows through an electrolytic cell containing a solution of HgI_2 and KI, a Hg anode and Ir or C kathode. Such a cell is free from polarisation and changes of concentration. By determination of the amount of Hg set free at the kathode the current is integrated and thus the air flow also; (2) the wind vane is connected rigidly to an arm which moves over eight contact strips and these serve to mark the eight main wind directions. Each strip is connected to its own electromagnetic counter and all are joined in parallel and connected to another, the main counter. The anemometer cups close an electric circuit after each run of 100, 200 or 500 m. and a current passes through the arm to one of the strips and thence through the main counter. The air flow along each of the eight directions and for all directions in any interval can thus be found. These forms of apparatus avoid the less satisfactory method of integrating observed values of wind direction and speed at definite intervals through the period of time. R. S. R.

4838. Correlation Between the Amounts of Cooling of a Dry and a Damp Air Mass. M. Robitzsch. *Gerlands Beitr. z. Geophys.* 37. 1. *pp.* 89–93, 1932.—An equation is given for heat flowing through unit area of the boundary $\left(\frac{dW}{dt}\right)_t = c_p \cdot \frac{dm}{dt} \cdot (T_0 - T_1)$, where c_p is the specific heat of the air at constant pressure, T_0 and T_1 the respective temperatures of the surface of the body and the surrounding air, dm/dt, and the ventilation factor, *i.e.*, the interchange through unit area of the boundary in unit time between the body and the surrounding air. For damp air the corresponding equivalent temperatures must be used. The paper deals mathematically with the relative values of dm/dt and the means by which the relative heat flow can be calculated. R. S. R.

4839. Summer Temperature Curve During the Ice Age. R. Spitaler. *Gerlands Beitr. z. Geophys.* 37. 1. *pp.* 94–103, 1932.—The author extends a table given in a previous paper [see Abstract 3160 (1932)] to obtain the probable summer temperatures for latitude 40° N., times and corresponding eccentricities being inserted. These show 74 perihelion periods in the last 1,510,000 years. A mean period of 20,000 years is taken and the curve for summer temperature plotted. The general conditions for increase and decrease of glaciation with varying eccentricity and perihelion are discussed. He finds (1) the Günz ice age at the period −1,336,600 to −1,200,000 years with a local reversal in this period; (2) the Mindel ice age at −974,760 to −817,940 years with a temporary reversal; (3) the Riss age at −592,030 to −550,600 or −456,240 years, but it is of two parts; and (4) the Würm ice age −231,920 to −165,000 years, but a temporary break occurs and it is then cold to −72,290 years. The effects of precipitation and sea temperatures and possible further progress in the investigations are considered. R. S. R.

4840. Last Phase of the Ice Age in Scandinavia and N. America. R. Spitaler. *Gerlands Beitr. z. Geophys.* 37. 1. *pp.* 104–108, 1932.—The most favourable conditions for glacial retreat are a warm, dry summer and a mild winter, and eccentricity of the earth is most important. Changes of perihelion during the last 110,000 years are tabulated for each 10,000 years with the mean eccentricity for each period. De Geer's conclusions regarding the end of the last ice age in Scandinavia, North America, the Himalayas and the Argentine are criticised. The author considers that the end for the Argentine occurred at 22,020 to 19,240 years before 1850 while for North America it occurred around 33,360 years before 1850. In Scandinavia the retreat occurred about 21,000 years later than in North America. R. S. R.

4841. Determination of Slope of Sea-Bed. P. Marti. *Comptes Rendus,* 195. *pp.* 528–530, *Sept.* 12, 1932.—A method is proposed to determine the slope of the sea-bed from a single echo-sounding. The method depends for its success on the recording, by oscillographic or other means, of at least three successive top and bottom echoes. On a sloping smooth bottom the time-intervals separating these successive echoes will decrease (or increase) at a rate which yields in a simple manner the required information regarding the slope of the sea-bed. A. B. W.

4842. Period of Free Oscillation of Incompletely Enclosed Water Masses (Mouth Correction with Seiches). H. Lettau. *Gerlands Beitr. z. Geophys.* 37. 1. *pp.* 41–48, 1932.—If a lake communicates with the open sea, the period of the free oscillations of the lake will be influenced by it. For this " mouth correction " a simple analytical expression is developed on the basis of obvious physical conditions and consisting essentially of a simple elliptical integral. Observations of the uninodal and binodal seiches of the Kurisches Haff, Eastern Prussia, which is connected with the Baltic Sea by the Memel deep-water channel, show a satisfactory agreement with theory. R. S. R.

4843. Diffraction of Elastic Waves at the Boundaries of a Solid Layer. J. H. Jones. *Roy. Soc., Proc.* 137. *pp.* 325–343, *Aug.* 2, 1932.—The diffraction of elastic waves at the boundaries of a hard limestone bed forming the oil reservoir of one of the Persian oilfields has been studied. The overburden, consisting of gypsum, salt, shales and sandstones, is several hundred feet thick. Several diffraction pulses are observed at the surface. The first (weak) pulse travels along the upper boundary of the bed at the speed of the compression wave. Other pulses, of greater energy and more constant velocity, appear to be formed by the critical reflection of distortional pulses at the lower boundary; some of these distortional pulses are internally reflected within the limestone layer and arrive later at the surface. The higher velocity is due to the greater compactness of the base of the bed. H. F. G.

4844. Experimental Seismology and Its Applications. F. Müller. *Gerlands Beitr. z. Geophys., Angew. Geophys.* 3. *pp.* 125–136, 1932.—When the conditions of observations are the same, differences occur in the seismograms for waves of different frequencies and in media of different material. The qualitative and quantitative results of seismological observations without the use of time-distance graphs are reviewed for the cases of (1) waves in the upper layer only, (2) reflection from the lower layer and (3) a fault in the upper layer. Formulæ are developed for these cases and the position of the fault can be found to narrow limits. Practical applications of the formulæ have been made to known geological strata and the errors are under 10 %. R. S. R.

4845. Theory of Propagation of Seismic Waves. J. Picht. *Gerlands Beitr. z. Geophys., Angew. Geophys.* 3. *pp.* 1–8, 1932.—The movements at a point on the surface resulting from strongly damped waves proceeding from a centre of disturbance in the upper layer of the crust and giving rise to spherical waves diverging from their points of impact on the under surface of that layer are calculated by means of Huygens' principle. C. A. S.

4846. World-Shaking Earthquakes and Pole Shift. H. Nagaoka. *Imp. Acad. Tokyo, Proc.* 8. *pp.* 284–287, *July*, 1932.—The real cause of minute fluctuations in the rotation of the earth seems to lie in magmatic changes, for volcanic activity seems to be correlated with the fluctuations. Presumably the variation of latitude is closely connected with that of rotation. Inspection of pole shift given by direct observations (not by smoothing) indicates a number of *sudden* fluctuations which occur from time to time, the real cause of which is obscure. Great earthquakes bend the course of the curve of pole shift, and the angular velocity is altered during the process. Deep earthquakes seem to affect the shift in spite of the feebleness of the shock. Apparently the magmatic changes begin a few weeks before the great earthquakes and subside after them. Most probably the prime mover of great earthquakes is more deep-seated than the foci, which only mark the weak points on the line of action of magmatic stress. W. A. R.

4847. Tilting and Strength of the Earth's Crust. T. Terada and N. Miyabe. *Imp. Acad. Tokyo, Proc.* 8. *pp.* 288–291, *July*, 1932.—A region of wide extent is tilted by an amount of the order of 10^{-5} in the case of land, and of 10^{-3} in the case of the sea-bed. These constant limits suggest a possible difference in the order of magnitude of the ultimate strength of the crust in land and sea-bed respectively. The sequence of gradual tilting and abrupt opposite motion seems to indicate a mechanism of elastic strain followed by breakdown. The strain may be of the nature of a tension exerted in a N–S direction. There is a remarkable coincidence in the direction and magnitude of the rate of tilting in the four peninsular districts. W. A. R.

4848. Distribution of Bombs from Volcanic Vent. T. Nomitsu and M. Namba. *Kyoto Coll. Sci., Mem.* 15. *pp.* 215–233, *July*, 1932. *In English.*—While observations were being made during eruptions of the fourth crater on Mt. Aso, Japan, it was especially noticed that the area of distribution of bombs round the equator was elliptical, with the centre of the ellipse eccentric from the vent. This was considered to be due to a cylindrical vent of great depth, with the pit not at the centre of the vent's floor. Then the range R_θ of bombs projected with initial velocity V on the atrio for vent depth h and distance λ_θ of pit from vent wall in azimuth θ is $R_\theta = mh\lambda_\theta(V^2 - gh)/g(h^2 + \lambda_\theta^2)$. This in general represents an elliptic curve and so upholds observations. H. M. B.

4849. Krakatoa Eruption. G. Agamennone. *Accad. Lincei, Atti,* 16. *pp.* 127–133, *Aug.*, 1932.—It has been stated that the repercussion of the explosion of Krakatoa was heard across the globe. The evidence is re-examined and does not support the statement. W. A. R.

4850. Applied Geophysics. A. O. Rankine. *Nature,* 130. *pp.* 421–424, *Sept.* 17, 1932. *Presidential Address to the British Assoc., York, Sept.* 2, 1932.—A semi-popular account of the methods—gravitational, seismic, magnetic and electrical—of geophysical surveying, and of their applicability and limitations, is given, with a somewhat more detailed account of Eötvös' balance, and suggestions for the construction of a magnetic instrument on similar lines to detect directly space variations of the earth's magnetic field. C. A. S.

4851. Torsion Balance and Geological Structure. F. Haarstick. *Gerlands Beitr. z. Geophys., Angew. Geophys.* 3. *pp.* 29–37, 1932.—The position and shape of a mass surrounded by a lighter, or a heavier, medium can be calculated from the gradients and curvature values of the mass, if the specific gravities of the mass and of the medium are known. The more exact the knowledge of the specific gravities the greater the accuracy of the result. The method has been applied to calculate the depth and position of salt domes with success. W. A. R.

4852. Theorem Relating to Electrical Anisotropic Regions and Its Application to D.C. Electrical Prospecting. R. Maillet and H. G. Doll. *Gerlands Beitr. z. Geophys., Angew. Geophys.* 3. *pp.* 109–124, 1932.—C. and M. Schlumberger showed in 1920 that electric ions have a greater mobility parallel than perpendicular to the strata in sedimentary formations, and thus act as anisotropic conductors in prospecting. The authors set out mathematically a theorem by which it is often possible to obtain the distribution of the electrical field in an anisotropic space from that of the field in a different but isotropic space. The method is then applied to a study of the principal types of tectonic structures. R. S. R.

4853. Magnetic Prospecting for Iron. E. F. Stratton and J. W. Joyce. *Bureau of Mines, Techn. Paper, No.* 528. [32 *pp.*], 1932.—The paper describes the Askania magnetometers used for the work, the corrections to be applied, and the method of use in the field. The application to four areas is also given, with details, instructions and precautions to be used in the field work and in the interpretation of observations. W. A. R.

4854. Year 1900 as Standard Equinox. E. C. Bower. *Astron. J. No.* 977. *pp.* 41–46, *Aug.* 9, 1932.—In meridian circle, asteroid and comet work, the use of a standard equinox to reduce the amount of work in computing the precession is advocated. The advantages of using 1900 as this standard are pointed out. G. C. McV.

4855. Measurement of the Personal Equation for a Meridian Instrument. A. Lambert. *Bull. Géodésique, No.* 31. *pp.* 185–189, *July, Aug.–Sept.,* 1931.—Although the movable filament for right ascension has reduced the observer's personal equation to 0·01–0·02 sec., this error is not negligible for modern measurements of differences of longitude. A description is given of a method by which a special apparatus is fitted, furnishing the eyepiece of the astronomical telescope with a reversing prism, permitting the reversal of the apparent sense of displacement of a star. Examples are given of its application. R. S. R.

4856. Horizontal Camera and Cœlostat for Astronomical Observations. H. v. Klüber. *Zeits. f. Instrumentenk.* 52. *pp.* 381–393, *Sept.,* 1932.—Eclipse expeditions for Einstein effect and other temporary stations require transportable apparatus for precise astrometry. Apparatus used in Sumatra, 1929, developed by Freundlich and Messrs. Zeiss, is fully described and illustrated. The principle is a horizontal camera capable of rotation on rails about a precision cœlostat to which it is attached. The drive of the cœlostat presents novel features, designed to eliminate the risk of irregularity in a few minutes' exposure. Formulæ and tables for the adjustment are given. T. L. M.

4857. Surface Brightness of Threshold Images. E. Hubble. *Astrophys. J.* 76. *pp.* 106–116, *Sept.*, 1932.—A study of threshold images of stars photographed on Eastman 40 plates with the 100-in. and 60-in. reflectors and various cameras indicates a relation between surface brightness and size of image according to which the surface brightness diminishes as the size increases, at first rapidly and then more and more slowly. The relation has been studied for images ranging from the smallest focal images up to extra-focal images 1 cm. and more in diameter. For very small images the total magnitudes are independent of the size; for very large images the surface brightness is independent of the size. The observed relation is a smooth transition between these limiting conditions. The relation has been determined numerically for the two reflectors and used to derive statistical values for limiting magnitudes corresponding to nebular images of various dimensions. AUTHOR.

4858. Surface Brightness and Phase-Angle for Illuminated Spheres. C. Wirtz. *Zeits. f. Astrophysik,* 5. 1. *pp.* 21–35, *Aug.* 28, 1932.—An experimental investigation of the surface brightness of a white sphere, reflecting light diffusely, with the phase angle under which the sphere is observed. On comparison of the results obtained by using a sphere of white chalk, with those found for the planets, it is shown that agreement is fairly close. The conclusion is drawn that photometric measurements of the light from the planets give no indication of the constitution of their reflecting atmospheres. G. C. McV.

4859. Intensity Distribution in the Violet CN Band System in the Spectra of Comets. K. Wurm. *Zeits. f. Astrophysik,* 5. 1. *pp.* 10–20, *Aug.* 28, 1932.—It is shown that the anomalous intensity distribution in the violet CN bands as observed in the spectra of comets can be explained on the assumption of a very low temperature. The striking sharpness of the head of the principal band λ3883 is explained by assuming a fluorescent excitation by the sun's radiation. J. E. K.

4860. Heliodon for Demonstrating the Apparent Motion of the Sun. A. F. Dufton and H. E. Beckett. *Journ. Sci. Instruments,* 9. *pp.* 251–256, *Aug.*, 1932.—The methods of predetermining the insolation of a building are discussed and a new instrument, the heliodon, is described, with which scale models are readily examined. Examples are given showing the insolation of walls, the insolation within a room and the insolation of a street. AUTHORS.

4861. Photographs of the Sun. H. Strebel. *Zeits. f. Astrophysik,* 5. 1. *pp.* 36–49, *Aug.* 28, 1932.—A series of photographs of the sun's surface, some taken so that the light from the portion photographed left it normally, others taken with an ultra-violet filter, are discussed with special reference to the constitution of sun-spots, faculæ and granules observed. G. C. McV.

4862. Luminosity Distribution and Temperature of Sunspots. N. Barabascheff and B. Semejkin. *Zeits. f. Astrophysik*, 5. 1. *pp.* 54–59, *Aug.* 28, 1932.—Starting from the assumption that the increased brightness of the sun's surface in the neighbourhood of a sunspot is, in the main, an optical illusion, the authors give experimental curves for the distribution of brightness and temperature in sunspots. G. C. McV.

4863. Bright Inner Edge of Sunspot Penumbra. H. Strebel. *Zeits. f. Astrophysik*, 5. *pp.* 96–100, *Sept.* 30, 1932.—It has been stated that Secchi was mistaken in drawing a bright inner edge to many sunspots, separating the half-tones of the penumbra from the darkness of the umbra: this is not seen, and not registered by the bolometer, at Mt. Wilson. It is, however, visually observed at the Munich Observatory, and almost always appears on photographs taken with special ultra-violet plates, though sometimes it is faint, and often it varies in brightness in different parts of the spot. Possibly it is due to a kind of actinic radiation, not perceptible by the bolometer. M. A. E.

4864. Frequency-Dependence of the Continuous Absorption Coefficient of the Solar Atmosphere. A. Unsöld and A. W. Maue. *Zeits. f. Astrophysik*, 5. 1. *pp.* 1–9, *Aug.* 28, 1932.—Following on the investigation of Milne's integral equation by E. Hopf [see Abstract 1213 (1928)], a second approximation is found for the temperature distribution in the outer parts of a star which deviates only a little from the second approximations given by Eddington and Milne. On the basis of this temperature distribution the frequency dependence of the continuous absorption coefficient in the sun's atmosphere is calculated from observations by Abbot of the intensity diminution at the sun's edge compared with the intensity at its centre. Only a small variation of absorption coefficient with frequency is found; a much larger variation is predicted by atomic theory. The influence of absorption lines on the edge darkening of the sun is investigated. J. E. K.

4865. Application of Unsöld's Chromospheric Theory to the Balmer Lines. P. C. Keenan. *Astrophys. J.* 76. *pp.* 134–138, *Sept.*, 1932.—Photometric observations in the chromosphere outside of eclipse, previously carried out for Hβ [see Abstract 3649 (1932)], have been extended to Hα, giving the variation in width with height. The breadth of Hα decreases more rapidly than that of Hβ. Theoretical contours computed by Unsöld's equation for a height of 300 km. give relative widths of the two lines in fair agreement with the observations, and indicate that self-reversal in the chromosphere should be inappreciable in the higher lines of the Balmer series. AUTHOR.

4866. Excitation of Helium in the Chromosphere. P. C. Keenan. *Astrophys. J.* 76. *pp.* 139–143, *Sept.*, 1932.—The observed turbulent motion of the chromospheric gases may provide the atoms of calcium with velocities sufficient to excite atoms of normal helium by collisions. Whether such encounters are as effective as direct absorptions of ultra-violet radiation in exciting the helium spectrum cannot be decided from the data available. On the basis of Unsöld's measures of the brightness of D_3 in the chromosphere, the intensity of radiation required to produce the observed emission is estimated roughly as 10^8 times the amount that would be present if the sun behaved as a black body. AUTHOR.

4867. Effect of Collisions on Central Intensity of Fraunhofer Lines. R. v. d. R. Woolley. *Zeits. f. Astrophysik*, 5. 1. *pp.* 67–72, *Aug.* 28, 1932. *In English.*—The author's interpretation of high central intensities [see Abstract 1782 (1930)] has been criticised on the assumed constancy of the collision factor throughout the absorbing layers [see Abstract 1146 (1931)]. A model atmosphere is considered in which the collision factor is proportional to pressure, *i.e.*, to the square root of optical depth. Though this involves practically no collisions in the uppermost layers, the collisions are found to have a definite effect on the central intensity of the line. This individual effect should be more marked for ionised than for neutral elements. T. L. M.

4868. Study of the Solar Corona out of Eclipse. B. Lyot. *Zeits. f. Astrophysik*, 5. *pp.* 73–95, *Sept.* 30, 1932. *In French.*—An instrument has been installed in the Pic du Midi Observatory with which the corona and prominences are photographed, the coronal light is polarised and spectra of its bright lines are obtained. On this mountain, when the sky is cloudless and the air has been purified by a fall of snow, dust is practically non-existent, and the coronagraph has been built so as to eliminate as far as possible all diffusion of light in our atmosphere and in the instrument. It is worked in conjunction with two spectrographs, which can be used alternatively: one has a grating, the other a prism, and the latter can be converted into a spectroheliograph by means of a second slit. The direct photographs of the corona are difficult to take and very inferior to those obtained during eclipse, but the polarisation measures determine the form of the corona, and the bright-line spectra are of value, especially as high dispersion and very long exposures are possible. A green line at 5302·8 Å. has been photographed all round the sun in a series of 10 min. exposures, with the grating spectrograph and a dispersion of 1·2 Å. per mm. It varies in intensity in different regions, more or less in agreement with the varying brightness in different regions of the corona. A red ray at 6474·7 Å. requires 30 min. exposure with a dispersion of 11 Å. per mm. The lines 4232, 4086 and 3976 do not appear, so must be fainter than the red line. These results were obtained in 1930 and 1931: near sunspot maximum they should be much more complete. M. A. E.

4869. Spectroscopic Discoveries at 1930 Eclipse. S. A. Mitchell. *Am. Phil. Soc., Proc.* 71. 6. *pp.* 343–348, 1932.—In the solar eclipse of 1930 large dispersion was used and no slit, so that the coronal rings are complete and show detailed structure, particularly those at 5303 and 6374, though these details do not resemble each other nor the details at high level calcium K and Hα. The sun was very active for 4 days about the eclipse. The longest coronal streamers are not necessarily connected with the prominences of greatest height at the time of eclipse. It is usually assumed that coronal shape depends on solar activity. The author points out that though the connection between prominences and corona is the more apparent since both are seen stretching out from the edge, it is not necessarily stronger than with the sunspots not then seen because on the sun's face. He applies Ludendorff's work on the coronal shape [see Abstract 432 (1929)] and shows that the coronal types differ for equal times before and after the maximum and minimum of solar activity. The 1929 corona was essentially maximum type, that of 1930 (though still four years before the probable minimum date) was not medium type but essentially minimum. He had previously announced that the corona, two years in advance of both spot maximum and minimum, always takes on the characteristic shapes. A. S. D. M.

4870. General Catalogue of the Radial Velocities of Stars, Nebulæ and Clusters. J. H. Moore. *Lick Observat., Publ.* 18. [220 *pp.*], 1932.

4871. Binaries of Decreasing Mass. G. Armellini. *Accad. Lincei, Atti,* 16. *pp.* 77–81, *Aug.*, 1932.—The eccentricity of an orbit of a binary of gradually decreasing mass was believed by authorities like Jeans and Poincaré to be unchangeable, but the author proved in a previous note that it could even tend to infinity, however slow the decrease in mass [see Abstract 3662 (1932)]. He now gives a new and rigorous proof of his thesis, and concludes that the older binary systems are those that have a large eccentricity. E. E. F. d'A.

4872. Velocity Standards in O and B Type Spectra. J. A. Pearce. *Roy. Astron. Soc., Canada, J.* 26. *pp.* 262–266, *July–Aug.*, 1932.—In classes B and O most lines are free from the unavoidable blending in F to M stars, and the (less serious) blending in A stars; so that for the early stars it is possible to adopt values of wave-lengths which need not be revised for a considerable time. Two tables, therefore, are given of O and B stars (primary and secondary standards) as proposed at the 1928 I.A.U. Commission No. 30, in stellar radial velocities. The tables are limited to the region $\lambda\lambda$3900–5000, corresponding to the usual single-prism dispersion spectra, and notes on the lines are given. A. S. D. M.

4873. Wave-Lengths in A-Type Stars. W. E. Harper. *Roy. Astron. Soc., Canada, J.* 26. *pp.* 267–275, *July–Aug.*, 1932.—The author deals with the spectral lines in the A-type stars (the hydrogen stars so-called, because in them hydrogen reaches its maximum intensity), but the results obtained are applicable in some degree to the earlier F stars, where there is considerable blending. He used some empirical values of the blended wave-lengths that he had determined at Ottawa for the star 14 Aurigæ, and for comparison lines he used a table based largely on Burns, who had prepared it for B-type stars. An intercomparison of the results for all A-type stars in comparison with other observatories showed that the author is consistently negative by about 1 km. per sec. To obtain a working value of the wave-length concerned he studied a number of spectra of all types from A_0 to F_0, choosing spectra having lines both diffuse and sharp. The photographs were taken by single-prism dispersion with a camera of medium focal length; the results showed some lines with considerable systematic residuals, which persisted when additional spectra of similar character and type were examined. The combined results are given in two tables of wave-lengths. A. S. D. M.

4874. Thermal Doppler Effect and Turbulence in Stellar Spectra of Early Class. O. Struve. *Nat. Acad. Sci., Proc.* 18. *pp.* 585–589, *Sept.*, 1932.—The problem of the determination of the contours of absorption lines from measurement of stellar-spectrograms is discussed. The line-contours are usually so narrow that they cannot be regarded as free from instrumental effects. Visual observations of the best spectrograms taken with the Yerkes spectrographs show that in stars of very early spectral class the cores of the lines have approximately the width required by the theory of Doppler broadening. It is shown that a linear dispersion of 10 Å./mm. at 4500 Å. is barely sufficient to show the effect of Doppler broadening in the hottest stars. A dispersion of 5 Å./mm. should suffice to measure the effect in those helium lines which are immune from Stark effect. Broadening due to turbulence is not a phenomenon characteristic of early-type stars. J. E. K.

4875. Intensities of Stellar Absorption Lines. O. Struve and W. W. Morgan. *Nat. Acad. Sci., Proc.* 18. *pp.* 590–594, *Sept.*, 1932.—It is observed that the relative intensities of the absorption lines of a multiplet often differ very considerably between the spectra of stars of the same spectral class. Examples of varying intensity gradients within multiplets of OII, FeI, FeII and TiII are given for a few stars. Possible causes of these striking variations are discussed and it is concluded that the most probable explanation of the variations is that the reversing layers of stars are not in thermodynamic equilibrium. J. E. K.

4876. 17 Leporis: A New Type of Spectrum Variable. O. Struve. *Astrophys. J.* 76. *pp.* 85–105, *Sept.*, 1932.—For this star [see Abstract 2211 (1931)], the normal spectrum persists without violent changes for long periods, and it shows no variability of light throughout thirty-four days (though this may have been during its normality). The author concludes that there is superposition of two spectra. One is of a normal A star with rotational broadening, showing H wings and diffuse Mg λ4481, and a radial velocity about 0 km./sec. The other is one with variable lines of H, FeII, FeI, etc., which always give negative velocities. A table is given of the spectral changes, and a plate of the spectra of 17 Leporis and ε Aurigæ; in the latter star the decline in intensity within the multiplet is slower than predicted by the square-root law, but faster in 17 Leporis—not as fast, however, as in emission, and it is difficult to interpret the result theoretically, for there is no pronounced thermal Doppler effect and therefore it is not due to temperature. The doubling of its lines and the radial velocity variations are not orbital. The author suggests that the first (A star spectrum) is the reversing layer, and the second originates in an expanding outer shell of gas as in P Cygni, but there is no present knowledge of forces that might cause the successive outbursts—certainly not radiation pressure, since the light is not variable. A. S. D. M.

4877. Composite Spectrum of the A-Type Star 14 Comæ. W. W. Morgan. *Astrophys. J.* 76. *pp.* 144–148, *Sept.*, 1932.—The A5 star 14 Comæ has been found to contain lines of various degrees of sharpness in its spectrum. A number of lines TiII and FeII are present which probably consist of a fairly narrow core directly superposed over a broad, shallow underlying line. There are also present several very broad, shallow lines most of which are near the limit of visibility. The MgII line λ4481 belongs to this latter class. All the other lines of the second spectrum are probably due to FeI. The radial velocities of the two sets of lines are identical, and it seems practically certain that the spectrum observed comes from one star only. A possible explanation of the origin of the spectrum somewhat similar to that found by Struve for 17 Leporis is given. The radial velocity of 14 Comæ is constant. AUTHOR.

4878. Intensities of Hydrogen Lines in Stars of the Pleiades. Y. Öhman. *Arkiv f. Mat., Astron., och Fysik, Stockholm*, 23*B*. 1. [6 *pp.*], 1932. *In English.*—Spectra of stars in the Pleiades down to the 11th magnitude have been photographed at the new Stockholm Observatory, and a study has been made of the relations between total absorption of the hydrogen lines, colour and luminosity. It is evident from the diagrams that these lines form a very sensitive criterion of luminosity in the high-temperature stars, and are distinctly correlated with it in those of low temperature. M. A. E.

4879. Heterochromatic Study of the Pleiades. Cecilia H. Payne. *Harvard Coll. Obs., Ann.* 89. 2. *pp.* 43–59, 1932.—With the intent of devising a system of colour photometry applicable to faint stars, and extensible to any base line of wave-length that may become available through the evolution of the photographic plate, experiments have been carried out on the Pleiades, which form a group of stars of well-determined colour. The system based upon these experiments can be applied to any suitable instrumental arrangement, with varying methods according to the different combinations of instrument, filter and plate. M. A. E.

4880. Number of Stars and Interstellar Absorption. K. F. Bottlinger. *Zeits. f. Astrophysik,* 5. 1. *pp.* 50–53, *Aug.* 28, 1932.—It is demonstrated theoretically that a quite different apparent distribution of stars is obtained when it is assumed that a given percentage of stars per unit distance are hidden by dark clouds than in the case when a continuous absorption in interstellar space is assumed. G. C. McV.

4881. Darkening at the Limb for Algol Variables. W. Krat. *Zeits. f. Astrophysik,* 5. 1. *pp.* 60–66, *Aug.* 28, 1932.—A calculation of the law of darkening at the limb of a star, when the opacity is a function of the wave-length of the light. The theory is applied to Algol eclipsing variables, in which the law can be deduced experimentally from the apparent disc of the star in the telescope. G. C. McV.

4882. Statistical Discussion of Photoelectric Colour-Indices of 738 Stars. W. Becker. *Zeits. f. Astrophysik,* 5. *pp.* 101–116, *Sept.* 30, 1932.—Preliminary survey of conclusions from the Berlin–Babelsberg colour indices, to which the author adds 662 observations of 356 stars. The connection between colour index and spectrum type is discussed; scattering of colour indices within each spectrum type shows a minimum round FO; *c*-stars diverge towards positive side of colour index range for both early and late types; results are given of an analysis of *n*-stars and *s*-stars: colour-index difference, *n–s,* $0^{m}\cdot008$, $0^{m}\cdot020$, for B, A stars respectively, absolute magnitude difference $0^{m}\cdot4$ for both types. Twenty-four Be-stars show no marked divergence from normal B-stars. The relation between absolute magnitude and variation of colour index within one spectral type is examined; there is general agreement with Sticker's result that the relation reverses its direction from early to late types. There is no general marked distance effect, but regions of positive and negative excess of colour index can be distinguished along the galactic equator; these are related to selective absorption; but are found to have no direct relation to the presence of the interstellar Ca lines. T. L. M.

4883. Theory of Stellar Structure. E. A. Milne. *Univ. Durham Phil. Soc., Proc.* 9. *pp.* 14–23, *June,* 1932. *Abstract.*—A non-mathematical account of the theory of "two-phase" (degenerate-gas core — perfect-gas envelope) models showing how these reproduce many properties of actual stars such as the existence of white dwarfs; of pairs of giant stars of different radii for given mass and luminosity; of Cepheid and Nova phenomena, and of an approximate mass-luminosity law. G. G. McV.

4884. Elimination of One Boundary Condition for a Sphere in Radiative Equilibrium by a Layer in Adiabatic Equilibrium. H. Roth. *Phys. Rev.* 41. *pp.* 327–330, *Aug.* 1, 1932.—In a previous paper [see Abstract 2352 (1932)] a solution of the equations for a slowly contracting or expanding fluid sphere in radiative equilibrium was obtained. In this solution, for particular values of the central pressure and temperature, a certain parameter, α, depending on the rate of contraction, determined whether or not the solution fulfilled the boundary conditions at the surface. For values of the parameter less than this critical value the solution is physically impossible. In this paper it is shown that an atmosphere in adiabatic equilibrium can be fitted to the solutions with values of α larger than the critical value. Thus the equations stating that p and T should approach zero together for some finite r and m are replaced by an inequality of which the completely radiative solution gives the limiting case. In general, the masses, radii and luminosities of such stars are larger, while the effective temperatures are smaller, than those of stars completely in radiative equilibrium. AUTHOR.

4885. Equilibrium between Matter and Radiant Energy. J. A. C. Teegan. *Phil. Mag.* 14. *pp.* 415–418, *Sept.*, 1932.—It is assumed that the conversion of matter into radiation depends on the temperature. It is then shown that the temperature necessary for matter to break up continually into radiation, and simultaneously for the radiation to condense into matter, is of the order of 10^{12}° Abs. G. C. McV.

4886. Hypothesis of Annihilation of Matter. H. Hönl. *Zeits. f. Physik,* 77. 5–6. *pp.* 317–321, *Aug.* 2, 1932.—A relativistic invariant formulation of the annihilation hypothesis is given which satisfies the laws of conservation of energy, of impulse and of charge. The method is also applied to a short deduction of the Compton–Debye formula. J. J. S.

4887. Bright External Galaxies. H. Shapley and Adelaide Ames. *Harvard Coll. Obs., Ann.* 88. 2. *pp.* 43–75, 1932.—A catalogue is presented of all the extra-galactic nebulæ brighter than 13th magnitude, giving the position, magnitude, diameter and type of each. 1249 objects are included, of which 701 are spiral, 217 spheroidal, 29 irregular and 78 are unclassified. Four diagrams illustrate the general unevenness of distribution, the avoidance of low latitudes, and the strong clustering in the northern galactic hemisphere. The region surveyed is approximately 100 cubic megaparsecs. [See Abstract 3672 (1932).] M. A. E.

4888. Nebulous Objects in Messier 31 Provisionally Identified as Globular Clusters. E. Hubble. *Mt. Wilson Observat. Contrib. No.* 452. *Astrophys. J.* 76. *pp.* 44–69, *July,* 1932.—These objects number 140 with absolute photographic magnitude ranging from − 4 to − 7, but a double maximum suggests a mixture of two homogeneous groups; their diameters are from about 4 to 16 parsecs; they decrease with distance from the nucleus of M 31; they are systematically fainter than the globulars in our galactic system, but the brighter members are comparable with those in the Magellanic clouds. Similar objects are found in connection with N.G.C. 6822, and MM. 33, 81 and 101. A. S. D. M.

4889. Distribution of Light in Six Globular Clusters. F. S. Hogg. *Astron. J. No.* 980. *pp.* 77–87, *Sept.* 15, 1932.—A search for a criterion which may give information, both of the structure and of the relative distances of the globular clusters, by means of the use of integrated light and extrafocal images. The material, instruments and methods are described. It appears that there is no radical dependence of mean spectral type on position in the cluster; ellipticities are not marked; it is evident from curves both of apparent and of space distribution of intensity (for Messier 2, 5, 13, 15, 22 and 92) that there is a general similarity in the curves and a marked difference in concentration between the various clusters, thus raising the question of dependence of concentration on the relative distances. For these six clusters, with ω Centauri and Messier 3, it is found that the range in distance as derived by assuming the distribution of intensity to be the same, is from 3 to 22 kiloparsecs, while the corresponding range from the modulus determination is 6·8 to 13·9; from this the author concludes that either the distances by magnitude methods are in serious error (say, by absorption of light in space), or that clusters have not identical intensity distribution. He himself inclines to the latter. A. S. D. M.

4890. Hydrogen Emission in Gaseous Nebulæ. G. Cillié. *Roy. Astron. Soc., M.N.* 92. *pp.* 820–830, *June*, 1932.—According to Zanstra's theory of nebular luminosity the H spectrum in nebulæ is emitted on the recombination of protons and electrons. Expressions are derived for the numbers of captures on the various H levels. Without distinguishing between the sub-states of H, electron temperature has no marked effect on the theoretical Balmer decrement; this is shown to be contrary to observation for $H\gamma/H\beta$; it is therefore proposed that although temperature affects the relative numbers of captures on the different levels only slightly, it does greatly alter their distribution among the sub-states. The total Balmer spectrum energy is computed as a check of the order of magnitude. Energy distribution in the Balmer continuous spectrum is found to be very sensitive to changes in electron temperature, and may be used to determine this latter directly. The additional general nebular emission due to high state of ionisation of the hydrogen is found to be too faint for observation. T. L. M.

4891. Intensities of Nebular Lines and Mean Lives of Atoms Emitting Them. A. F. Stevenson. *Roy. Soc., Proc.* 137. *pp.* 298–325, *Aug.* 2, 1932.—*Mathematical.*—It is shown that, on the hypothesis that the mean interval between collisions between the emitting atoms in the nebulæ is at least as long as the mean lives of the atoms in the initial states, the mean time-interval is at least 26 sec. in regions from which the "nebulium" lines N_1 and N_2 are emitted, and at least 3 min. in regions from which the lines at 6583·6 and 6548·1 Å. are emitted. On the whole the results confirm Bowen's hypothesis of the origin of certain of the nebula lines, and also the assumption that these lines are due to quadripole radiation. H. F. G.

4892. Law of Force in Spiral Nebulæ. S. G. Hacker. *Astron. J. No.* 977. *pp.* 46–48, *Aug.* 9, 1932.—It is shown that the hypothesis put forward by Vogt to account for the shape of the spiral arms of the nebulæ, *viz.*, that the law of force is $F=-\frac{a}{r^2}+br$, where a, b are constants and the term br represents a repulsive force due to the expansion of space, is inadequate to account for the observed shapes. The theory gives spirals of quite different shape from those observed, and velocities for the arms a thousand times too small. G. C. McV.

LIGHT.

4893. Light Filters for the Mercury Lamp. E. J. Bowen. *Chem. Soc., J. pp.* 2236–2239, *Aug.*, 1932.—The lamp used was a Hanovia "Alpine Sun," d.c. model, running with 72 volts across the burner, which had been in use about 200 hours. The filters described, which will probably be found suitable for all mercury lamps in good condition, show the following features: (*a*) the infra-red is effectively removed, even from the ultra-violet filters; (*b*) the number of separate filters is reduced to a minimum; (*c*) the transmission is high with good "monochromatism"; (*d*) the stability of the filters under given energy conditions has been investigated. H. H. Ho.

4894. Absorption of Balmer Lines in Neon-Hydrogen Mixtures. T. Takamine, L. S. Ornstein and J. M. W. Milatz. *Zeits. f. Physik*, 78. 3–4. *pp.* 169–176, *Sept.* 21, 1932.—A gas-discharge tube filled with Ne containing a trace of H_2 was used. This was excited by a condensed discharge and the absorption investigated photographically. Schrödinger's theory of the probability of absorption is proved. F. S.

4895. Change in the Infra-Red Reflecting Power of Bismuth in a Magnetic Field. J. C. McLennan, E. J. Allin and A. C. Burton. *Phil. Mag.* 14. *pp.* 508–512, *Sept.*, 1932.—The effect of a magnetic field on the infra-red reflecting power of a cast Bi mirror was found experimentally to be practically nil, and hence very much less than would be anticipated from electromagnetic theory and a knowledge of the change of conductivity of Bi for d.c. in a magnetic field. It is suggested that the change of conductivity in a magnetic field may be much less for a.c. than for d.c. J. S. G. T.

4896. Cyclo-Rotational Powers of the Eyes. J. Adamson. *Optical Soc., Trans.* 33. 5. *pp.* 189–198, 1931–1932.—If a subject's head is fixed in the normal position and he directs his eyes upwards or obliquely to view a horizontal line test object, then the two images on the respective retinæ will be unable to fuse binocularly, unless the eye globes can execute compensatory rotations about their front to back axes. The angle of rotation which the "cyclo-rotational" power of the eye must provide to ensure fusion is computed for all directions of view. Experiments showed that in practice the eye can cyclo-compensate within a certain large field, and that beyond the limits of this cyclo-diplopia sets in. Cyclo-rotations of at least 17° (sum for the two eyes) are obtainable, although in normal conditions of binocular vision cyclo-rotations exceeding 1·6° will rarely be required. W. S. S.

4897. Photoptometer for Determining the Light Threshold and Visual Acuity at Low Brightnesses. E. Haas. *Rev. d'Optique*, 11. *pp.* 306–312, *Aug.*, 1932.—The optical system consists of a line filament lamp which is imaged, by a lens A, on a slit the jaws of which cut the filament image at right angles. A second lens B projects an image of the first lens on to a disc of opal glass which is viewed from the other side by the subject. This arrangement gives a circular patch of light of uniform brightness, the value of which can be varied by opening or closing the slit, or by rotating in front of the slit a cam so cut as to give any desired law of variation of brightness with time. For determining the visual acuity, use is made of a series of opal discs carrying Landolt broken circles of different sizes. W. S. S.

4898. Diamond Windows for Withstanding Very High Pressures. T. C. Poulter and F. Buckley. *Phys. Rev.* 41. *pp.* 364–365, *Aug.* 1, 1932.—Diamond windows have been tested out and found to withstand much greater pressures than glass or fused quartz windows (up to 21,500 atmospheres), particularly when water and alcohol solutions are used to transmit the pressure to the windows. AUTHORS.

4899. Effect of Pressure on the Index of Refraction of Paraffin Oil and Glycerin. T. C. Poulter, C. Ritchey and C. A. Benz. *Phys. Rev.* 41. *pp.* 366–367, *Aug.* 1, 1932.—A refractometer for measuring the index of refraction of liquids under very high pressure is described. The values obtained for glycerin and a paraffin oil, together with the constants for the Lorenz-Lorentz relation, are tabulated. AUTHORS.

4900. Refractive Index of Liquid Mixtures Containing Acetic Acid. N. A. Puschin and P. G. Matavulj. *Zeits. f. phys. Chem.* 161. *Abt.A.* 4. *pp.* 341–345, *Sept.*, 1932.—The refractive indices (n) of the six binary systems containing acetic acid and either aniline, mono- or dimethylaniline, quinoline, phenylhydrazine or pyridine have been determined as a function of the concentration c. The n–c curves are all concave towards the c axis. The concentration at which the deviation of n from the value calculated additively is a maximum is 75 mol.-% acetic acid for the mixture containing pyridine, and 66·6 mol.-% in the other cases. The compound existing in the liquid phase is therefore the same as that which separates on cooling, except in the case of pyridine. H. F. G.

4901. Determination of Refractivity Temperature Coefficients for Liquids. J. J. Manley. *Phys. Soc., Proc.* 44. *pp.* 556–562, *Sept.*, 1932.—In this paper attention is directed chiefly to the problem of measuring with precision the changes in the refractivity of a liquid for small alterations in temperature. An elaborated Jamin interferometer is described, as are also the several pieces of auxiliary apparatus necessary for setting up and maintaining differences in the temperature of the two interferometer tubes. Further, there is given a plan for measuring, by means of platinum resistance thermometers, differences in the temperature of the two tubes. AUTHOR.

4902. Limitations of a Blanket Calibration Chart for Reading Dispersions on the Abbe Refractometer. L. E. Dodd. *J.O.S.A.* 22. *pp.* 477–487, *Sept.*, 1932.—The usefulness of the Abbe refractometer equipped with compensating prisms can be limited seriously, for measurement of dispersions, by too liberal application of a blanket calibration chart to many individual instruments. Such a chart has been checked by calculation directly from the Abbe question for the dispersion. Incidentally, this basic formula is given in detail, in the algebraically exact and the approximate form, and also its derivation, which is not widely available. In addition, the expression was derived entirely in terms of the D-index of the test substance as the single independent variable, which it is ultimately, a form not appearing in Abbe's treatise. AUTHOR.

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4903. Optical Properties of Some Derivatives of Lower Aliphatic Alcohols and Aldehydes. W. M. D. Bryant. *Am. Chem. Soc., J.* 54. *pp.* 3758–3765, *Sept.*, 1932.—Optical properties of the crystalline 3 : 5-dinitrobenzoates of nine alcohols and 2 : 4-dinitrophenylhydrazones of five aldehydes, all of the saturated aliphatic series, have been determined. Acetyldehyde 2 : 4-dinitrophenylhydrazone is reported as a new example of crossed axial plane dispersion in crystals. C. B. A.

4904. Photodichroism and Photoanisotropy. Part XII. F. Weigert. *Zeits. f. phys. Chem.* 18. *Abt.B.* 1. *pp.* 73–87, *July*, 1932.—A modified half-shade dichrometer is described with photographs and method of use. A method of determining simultaneously photodichroism and double refraction is given. The author now decides to call the photodichroism negative when the absorption in the direction of the electric vector of the exciting light decreases after excitation. [For Part XI see Abstract 2816 (1932).] J. E.

4905. Optically Active Diazo-Camphor. W. A. Noyes and E. Meitzner. *Am. Chem. Soc., J.* 54. *pp.* 3768–3773, *Sept.*, 1932.—Amino-*d*-camphor has been separated into two amines with specific rotations $[\alpha]_D$ 17·5° and 55·5° respectively. The diazo-camphors prepared from them were proved to be identical, and the theoretical aspect of this fact is discussed. C. B. A.

4906. Influence of Intramolecular Vibrations on Optical Activity. W. Kuhn and H. L. Lehmann. *Zeits. f. Phys. Chem.* 18. *Abt.B.* 1. *pp.* 32–48, *July*, 1932.—The absorption rotation and circular dichroism of *β*-octylnitrate in hexane in the visible and ultra-violet have been measured. There is no rotation associated with the absorption at 2300 Å. but at the weaker absorption band 3650 Å. both anomalous rotation and circular dichroism were observed. These bands were examined in detail, and it was found that at the long-wave end there is a reversal of the dichroitic effect, indicating that the bands really consist of two overlapping ones having different electron levels. It is concluded that the optical properties associated with a band depend mainly on the electron jump and not on the vibration levels in it. In each single band the middle shows the most anisotropy. This is taken to mean that the molecules associated with absorption at the ends of a band are those distorted by the solvent molecules. The rotation determined from the dichroism curves agrees with the observed values as well as the approximate formula and the limits of measurement permit. J. E.

4907. Optical Rotatory Dispersion in the Carbohydrate Group. T. L. Harris, E. L. Hirst and C. E. Wood. *Chem. Soc., J. pp.* 2108–2120, *Aug.*, 1932.—In order to investigate the cause of the breakdown of Hudson's *iso*-rotation rules in the case of *α*-mannose and its derivatives, the rotatory dispersions of a number of carbohydrate derivatives have been investigated over the range 6708–2380 Å. Although deviations from simple dispersion were found in most cases in the ultra-violet, in the visible region in every case they were so small that the character of the rotatory dispersion will not account for the failure to conform with Hudson's rules. It is suggested that these rules cannot be used when the stereochemical arrangement of the groups round the first three C atoms of the sugar molecule is similar to that in *α*-mannose. The influence of *cis*- and *trans*-

groupings on the character of the rotation is noted, and the cause of the deviations from simple dispersion is discussed. C. B. A.

4908. Dipole Moment of Solvents and the Rotatory Power of Dissolved Menthyl Dialkylmalonates. H. G. Rule and J. T. R. Ritchie. *Chem. Soc., J. pp.* 2332–2340, *Sept.*, 1932.—Investigation of the optical properties of the menthyl esters of malonic and dialkylmalonic acids in solution leads to the following conclusions: (*a*) The rotatory powers of the di-esters decrease in the direction methyl → butyl. A temporary maximum occurs at dipropyl-, which is accentuated in solvents of low polarity, but disappears in highly polar solvents. (*b*) The sensitivity of the di-esters toward solvent influence increases with the length of the alkyl chain. Using a series of eleven benzene derivatives as solvents, the molecular rotation of dipropyl- and di-butyl malonates varies with the dipole moment of the solvent. A similar relationship occurs in menthyl acetate and dimenthyl phthalate, but no regularity is found with the malonate, dimethyl- and di-menthyl-malonates, nor with the oxalate. (*c*) Dimenthyl oxalate has been obtained in a low-melting form, m.p. 39°. C. B. A.

4909. Magnetic Birefringence of Rare-Earth Salts in Aqueous Solution. C. Haenny. *Comptes Rendus*, 195. *pp.* 219–221, *July* 18, 1932.—Measurements have been made for the nitrates in solution, using the large electromagnet already described [see Abstract 1186 (1932)], and for the mercury line 5461 Å. The results are given. It is concluded that the negative value given previously for erbium by the author and others is due to the presence of holmium, and that pure erbium has a positive double refraction. The magnetic double refraction appears to be proportional to the square of the field, but to have no simple relation to the atomic magnetic moments. J. E.

4910. Magnetic Birefringence in Solutions of Sodium Chlorate and Sodium Bromate. S. W. Chinchalkar. *Indian Journ. Phys.* 7. *pp.* 317–321, *Sept.* 1, 1932.—Sodium chlorate and sodium bromate in aqueous solutions are found to exhibit a feeble magnetic birefringence, negative in sign, and smaller in magnitude than that shown by nitrates, as was predicted by Krishnan from his observations on the magnetic anisotropy of potassium chlorate crystal. The optical anisotropy of the chlorate ions, calculated from the magnetic birefringence and Krishnan's data, comes out of the same order of magnitude as is to be expected from the known birefringence of the crystal. AUTHOR.

4911. Electric and Magnetic Birefringence. G. Bruhat and M. Pauthenier. *Congrès International d'Électricité, Paris, Sect.* 1, *Rapport No.* 32. [52 *pp.*], 1932.—The first part of this report contains experimental details of the Kerr effect and of its technical applications, and accounts of the molecular theory of the phenomenon, covering the variation of Kerr constant with wave-length and physical conditions, and of its chemical significance in relation to other optical and electric properties. In the second part, the Cotton–Mouton effect is treated in a similar way. C. B. A.

4912. Magnetic Rotatory Power of Cerium Chloride. (Miss) J. Pernet. *Comptes Rendus*, 195. *pp.* 376–378, *Aug.* 1, 1932.—Aqueous neutral solutions of $CeCl_3 . 7H_2O$ were investigated at different tempera-

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tures. With a given solution, the substance follows the law: $G(\tau - \theta) = \text{constant}$ (similar to Weiss' law), where G is the specific magnetic rotatory power [see Abstract 3973 (1930)]. Details of the optical properties are given. G. E. A.

4913. Magnetic Rotation and Zeeman Components. W. Schütz. *Zeits. f. Physik.* 77. 7–8. *pp.* 437–445, *Aug.* 6, 1932.—Observations of minimum rotation of polarisation between the Zeeman components of the D lines were made, and a general formula for calculating the number of dispersion electrons is deduced. A simple method of observation is described. F. S.

4914. Magnetic Rotatory Polarisation. R. de Mallemann. *Congrès International d'Électricité, Paris, Sect.* 1. *Rapport No.* 31. [28 *pp.*], 1932.—Accounts are given of the Faraday effect, its measurement and the results obtained, including the chemical applications. The earlier theories of the phenomenon are described briefly, and the modern molecular theory in more detail. Recent work on the paramagnetic rotations of crystals is also outlined. C. B. A.

4915. Faraday Effect in Molecules. R. Serber. *Phys. Rev.* 41. *pp.* 489–506, *Aug.* 15, 1932.—By taking account of the perturbation of intensities, as well as of energies, by the magnetic field, a new general expression for Verdet's constant in mono-, di- and polyatomic molecules is deduced, which is valid for frequencies well removed from absorption lines. For atoms, this expression reduces to that given by Rosenfeld, but it differs from that obtained by Kronig for diatomic molecules. It contains dia- and paramagnetic terms of the usual type, with additional new terms, but the paramagnetic terms are shown to vanish for non-linear polyatomic molecules and for linear molecules in Σ states. The classical Becquerel formula should be applicable to the rotations of gases in the visible and near ultra-violet. For frequencies near an absorption line, only the perturbation of energies need be considered. The rotations observed in iodine and in the alkalies are discussed. C. B. A.

4916. Faraday Effect with X-Rays. D. K. Froman. *Phys. Rev.* 41. *pp.* 693–700, *Sept.* 15, 1932.—Voigt's theory for the rotation of the plane of polarisation of light by a magnetic field is discussed and one of the equations used by W. Kartschagin and E. Tschetwerikowa [see Abstract 1415 (1927)] who investigated the Faraday effect with X-rays transmitted through ferromagnetic materials, is shown to be inapplicable. The theory for the effect given by Drude is modified for the case of X-ray wave-lengths giving a rotation of $\chi = -2\pi\mu e I L/mc^2$ radians. μ is the refractive index, I is the intensity of magnetisation, l the thickness of the material through which the X-rays are transmitted. The other quantities have their usual meanings. Kartschagin and Tschetwerikowa found evidence suggesting a rotation in the case of X-rays. An experiment was performed which confirmed these suggestions and which checked the equation for χ given above well within the experimental error. The experimental error was large, but a rotation of the order of 10° was shown to occur for X-rays of wave-length 0·3 Å. transmitted through 0·05 cm. of iron in a field of 300 gauss. AUTHOR.

4917. Polarisation of Light Scattered in Gases. S. Parthasarathy. *Indian Journ. Phys.* 7. *pp.* 139–157, *May* 15, 1932.—Light scattered in gases is found to be imperfectly polarised. The degree of depolarisation is examined for 39 gases and vapours, using direct sunlight. Argon shows a definite depolarisation of 0·56 %. For molecules of type RX_4, anisotropy increases with decreasing size of the X atoms and increasing size of the R atoms. OH and NH_2 entering a hydrocarbon seem to lower the depolarisation, while Cl seems to enhance it. Ethane, ethylene and acetylene show progressive increase in anisotropy. As Cl is progressively substituted in CH_4, there is an increase of depolarisation, followed by a decrease (maximum at CH_2Cl_2). Depolarisation increases in the series HCl, HBr, HI. The depolarisation of COS is less than for CO_2 or CS_2. CO and NO both have very small depolarisations compared with CO_2 and N_2O. A. C. M.

4918. Transmission of Light through Suspensions of Powdered Crystals. B. Mukhopadhyay. *Indian Journ. Phys.* 7. *pp.* 307–315, *Sept.* 1, 1932.—The problem of transmission of light through a suspension of randomly orientated particles is worked out. The expression obtained shows in agreement with experiment a much smaller transmission for a suspension of doubly refracting particles than for those of an isotropic body. It is further shown that if the incident light is polarised, the transmitted light is also completely polarised, but it is overlaid by an admixture of strong scattered or diffused light which is unpolarised. AUTHOR.

4919. Optics of White Sols. Part I. Derivation of Absorption Coefficients. T. Casperson. *Kolloid Zeits.* 60. *pp.* 151–159, *Aug.*, 1932.—In view of the satisfactory results obtained on application of Mie's theory [see Abstract 594 (1908)] to other colloids, the coefficients of absorption of white sols are calculated for various refractive indices, wavelengths of the incident light and particle diameters. The theoretical assumptions for simple methodic measurement of the concentration, the degree of dispersion and the poly-dispersion are discussed and appear to be related closely to the practical results. In applying absorptiometry to quantitative analysis, considerable assumptions must be made, and exact experimental testing of the results obtained theoretically is required. In order to avoid the tedious calculations on the basis of theory, curves and tables are given which, under certain assumptions, allow of the calculation of the coefficient of absorption for any sol. T. H. P.

4920. Transmission of Light through Cloud Particles. D. Nukiyama and A. Kobayasi. *Tokyo Univ. Aeronaut. Research Inst., Report No.* 82. [18 *pp.*], *Aug.*, 1932. *In English.*—Experiments were carried out to determine the transmission of light through clouds of water and NH_4Cl particles. A spectrograph was used to disperse the light, and the light intensity determined from the blackening of photographic plates. For NH_4Cl particles a maximum transmission was obtained at 4580 Å., a result similar to Pfund and Silverman's. For water particles there was a sharp maximum at 4780 Å. and a minor one at 3600 Å., similar to Houghton's results. For a mixture of water and NH_4Cl particles the maximum was at 4400 Å. The results obtained do not satisfy the theoretical relations of scattering deduced by Rayleigh. The condition that the dimensions of the particles should be small compared with the wave-length is not satisfied in the experiments but generally fogs are more transparent for the longer wave-lengths due to scattering by the water particles. The results for visible radiation only are given, and those for the infra-red are to be given later. R. S. R.

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4921. Wave-Length Dependence of Light Scattering by Atmospheric Particles. F. Linke and H. v. d. Borne. *Gerlands Beitr. z. Geophys.* 37. 1. *pp.* 49–72, 1932.—Laws of scattering of light according to Rayleigh and others are cited and considered with respect to field experiments. In order to obtain more exact data an apparatus is shown for use in a laboratory; in an enclosed space clouds of smoke, having particles of known and varied sizes are examined either dry or moist. No dependence on the wave-length is to be expected for mists. Israel has experimented on ions of radius less than 6×10^{-6} cm., and, since the smallest artificial particles examined have a radius $3 \cdot 5 \times 10^{-4}$ cm., there is still a gap to be covered. H. M. B.

4922. Geometrical Optics. C. W. Oseen. *Arkiv f. Mat., Astron., och Fysik, Stockholm,* 23 *A*. 1. [51 *pp.*],1932. *In German.*—Mathematical. In Part I the theory of the astigmatic beam, and in Part II the relationships between a surface and its evolute, are developed with particular reference to the work of Gullstrand. C. B. A.

4923. Reciprocal Spherical Aberration of an Optical System, including Higher Orders. H. F. Bennett. *Bureau of Standards, J. of Research,* 9. *pp.* 187–225, *Aug.*, 1932.—The aberration present when an axial point is imaged by a centred system of spherical optical surfaces may be expressed by any one of a number of power series. In this paper the reciprocal of the distance between the intersection of a ray with the axis and a fixed point on the axis is expressed as a series in h, where h is the perpendicular distance from the ray to the fixed point. Formulæ are derived by which the constant coefficients of the series expressing the aberration in the image space of a single spherical surface may be computed if the corresponding coefficients for the object space are known, the fixed point of reference being the centre of curvature of the surface. These formulæ cannot be used in the case of a plane surface since there is no centre of curvature. Accordingly, after developing transfer formulæ by which the aberration may be referred to a new point of reference, a second set of formulæ is derived in which the point of reference is taken as the vortex of the surface. A final set of formulæ expresses the longitudinal in terms of the reciprocal aberration. As a numerical example, the computation of the aberration of the third, fifth and seventh orders of an ordinary photographic "landscape" lens is given in full. Its results compare favourably with those of a trigonometric tracing of rays in which seven-place tables were used. In conclusion, the convergence of these series is briefly discussed and some relations to diffraction theory are pointed out. AUTHOR.

4924. Anamorphosis and Other Optical Devices. H. W. Lee. *Phot. J.* 72. *pp.* 352–360; *Disc.*, 360, *Aug.*, 1932.—A full historical and descriptive account of devices (*e.g.*, crossed but separated cylindrical lenses) for producing systematically distorted optical images. Many suggested photographic applications are critically discussed, but the only ones possessing real advantage are those in which changes in one dimension are required, *e.g.*, the imaging of illuminated slits or of luminous filaments, as in sound-recording procedure. L. V. C.

4925. Elementary Wave-Theory Derivation of the Focal Properties of Concave Mirrors and Lenses. W. Westphal. *Zeits. f. Physik,* 77. 9–10. *pp.* 644–648, *Aug.* 24, 1932.—A simple derivation of the focussing relationships in concave lenses and mirrors is made on the basis of the fact that all the optical paths from object to image must be equal. C. B. A.

4926. Formation of Images by Lens Trains and by Continuously Stratified Media. H. R. Schulz. *Zeits. f. Physik*, 78. 1–2. *pp.* 17–20, *Sept.* 8, 1932.—It is shown that the path of a ray through a large number of similar lenses can be treated as a sine curve, and thus approximates to that in a medium consisting of cylindrical strata, the two cases being analogous within limits. C. B. A.

4927. Correction of Lenses for Photography in the Infra-Red. H. W. Lee. *Journ. Sci. Instruments*, 9. *pp.* 277–279, *Sept.*, 1932.—The sensitising of photographic plates to the infra-red spectrum has, besides scientific importance, practical utility in astronomical and terrestrial photography through a diffusing atmosphere. The method for "correcting" photographic lenses for this region of the spectrum for which the refractive indices of optical glass are not known is described. AUTHOR.

4928. Engineering Problems in Construction of Large Astronomical Telescopes. C. Young. *Junior Inst. Eng., J.* 42. *pp.* 529–545, *Aug.*, 1932.—The author describes refractors and reflectors, with their objectives and mirrors, mountings and domes, with their advantages, disadvantages and engineering limitations. He takes the particular case of the 74-in. reflector being made by Howard Grubb, Parsons & Co. for Toronto University. Its mounting is of the fork type (a compromise between the English and German forms), but the polar axis is kept short owing to the great weight it has to carry. The radial and thrust bearings within the south pier casting are designed to carry a working load of 18 and 32 tons respectively, the balls in the radial bearing being 2½ in. dia. The driving circle is 8 ft. dia., and in its rim are cut 960 teeth of 8 mm. circular pitch. The telescope tube is latticed, 21½ ft. long and octagonal in section, constructed of duralumin I beams, with duralumin cross members of I section, connected to the main members by means of steel gussets fixed with duralumin rivets; diagonal stays of round duralumin rod are fitted in each panel, threaded right- and left-handed at the ends into steel T pieces carried on steel pins passing through the inner and outer gusset plates and tightened up to a predetermined tension. In the top centre of the tube is a rectangular box made of ¼-in. steel plate with circular flanges; interchangeable mountings for Newtonian or Cassegrain mirrors are respectively attached to the lower flange. The cell for carrying the main mirror has on its lower side a worm-wheel for carrying the spectrograph. The mirror itself will be about 76 in. dia. and 11 in. thick, with a 6 in. hole, and will weigh 2½ tons. The dome will be covered with ½-in. Agasote sheeting, riveted on, with a thin sheet of copper outside, the inside also is covered with Agasote, a space of 2 ft. being left between the two; the weight of the rotating portion is about 80 tons. Diagrams and photographs are given. A. S. D. M.

4929. Parallactic Tolerances in Sighting and Measuring Telescopes. T. Malinowski. *Rev. d'Optique*, 11. *pp.* 346–351, *Sept.*, 1932.—Instrumental parallax can occur when the image of the distant object formed by the objective is displaced with respect to the cross-wires or graticule in the eye-piece. When the telescope is adjusted so that a given distant point is brought to a focus in the plane of the cross-wires there will in general be two limiting points one on either side of the given point, such that objects within these two limiting points are seen without perceptible instrumental parallax owing to the limited visual acuity of the eye. The positions of these limiting points are worked out in terms of the optical constants of the telescope, and assuming a visual acuity of 1′. It appears that for a fixed focus telescope the most advantageous adjustment for avoiding instrumental parallax is with the objective focussed not on the point at infinity, but on a point distant $Rg/0{\cdot}0003$ from the objective, where g is the magnification and R is the radius of the effective aperture of the objective. W. S. S.

4930. Optimum Characteristics of Night Glasses. Y. Rocard. *Rev. d'Optique*, 11. *pp.* 352–361, *Sept.*, 1932.—For a given size of object glass the apparent brightness and the apparent size of an object seen through a field glass, vary with the magnification in opposite senses. As increase of size and increase of brightness both improve visibility, an optimum magnification may be expected. The argument is complicated, however, by the fact that the visual acuity is controlled by the size of the effective pupil at the eye. The author analyses these different factors in detail, and draws the following practical conclusions in regard to night glasses. For a given diameter of objective, the diameter of the effective eye pupil should never lie outside the limits 2 to 6 mm. The value 2 mm. is appropriate for viewing very small objects. The value 6 mm. is advantageous when viewing large objects on very dark nights, and an intermediate value of 4 mm. may sometimes be desirable. W. S. S.

4931. Collimator Without Aberration. L. Lenouvel. *Rev. d'Optique*, 11. *pp.* 362–369, *Sept.*, 1932.—The optical system described is designed to produce in effect an object at infinity for testing cameras, etc., when the use of actual distant objects is inconvenient or impossible. The apparatus consists of a concave mirror and a point source placed at a distance away equal to the radius of curvature and in a position such that the lines joining the point source and the centre of curvature to the mid-point of the mirror are inclined at 60°. With this arrangement the sagittal focal line of the bundle of rays reflected by the mirror passes through the point at infinity. If now an objective (*e.g.*, a photographic lens), is brought into coincidence with the tangential focal line, an image of the sagittal focal line is formed on the sighting screen in the form of a figure eight. When the adjustment of the sighting screen is correct the constriction in the figure eight is situated at the mid-point. Other applications of the collimator are mentioned. W. S. S.

4932. Total-Reflection Refractometer. A. W. Tronnier and J. Picht. *Zeits. f. techn. Physik*, 13. 9. *pp.* 402–406, 1932.—Modifications of the Pulfrich refractometer are described in which, by means of double prisms of various types, the refractive index of the substance under examination can be deduced from the observed angles of emergence without a knowledge of the refractive index of the prism material itself. C. B. A.

4933. Photoelectric Polarimeter. G. Bruhat and P. Chatelain. *Comptes Rendus*, 195. *pp.* 370–372, *Aug.* 1, 1932.—To avoid the tediousness and difficulty involved in the photographic methods of studying the rotatory dispersion of active bodies in the ultra-violet region the authors describe an apparatus in which the two beams to be compared are only separated after having traversed the polarimeter tube, and are then made to fall on Pressler sodium photoelectric cells of quartz. The photoelectric currents are amplified by means of thermionic valves and then measured by means of a micro-ammeter. The sensitivity is specified for rays of wave-length 4358, 4046, 3660, 3341, 3130, 3021 and 2963 Å. H. L. B.

4934. Quartz Double Monochromator and Vario-Illuminator for the Region 0·2–3 mμ. C. Leiss. *Zeits. f. Physik.* 77. 5–6. *pp.* 412–414, *Aug.* 2, 1932.—A quartz double-prism monochromator is described in which lenses are replaced by the new Hochheim mirrors of high ultra-violet reflecting power. This has the advantage of perfect achromatism, and thus avoids refocussing for different wave-lengths. A spectrum of length 50 mm. can be obtained of the region 0·2–3 mμ. J. E. R. C.

4935. Wedge-Spectrograms Without Absorbing Wedges. O. E. Miller. *Zeits. f. wiss. Phot.* 31. *pp.* 131–145, *Sept.*, 1932.—Briefly considers the wedge-spectrograph for photographic photometry, pointing out the disadvantages of absorbing wedges and rotating sectors. In order to remove the selective absorption which occurs when wedges are used, Callier used a diaphragm with horizontal slots of decreasing length, and a cylindrical lens, this arrangement being modified by Hansen. Both of these systems are discussed, and a new optical arrangement is then described which again makes use of a diaphragm but does not require a diffusing glass, this having been a disadvantage in the other two systems. After briefly discussing the diaphragms and their method of production, several uses of the instrument are illustrated, and the factors limiting the usefulness of the instrument are given. Finally, two arrangements are suggested whereby it becomes possible to use the instrument for photographic spectrophotometry, and its uses for the comparison of spectral energy distribution curves of light sources and of the intensities of spectral lines are also emphasised. R. C. F.

4936. Use of Plane Transmission Gratings. H. M. Reese. *J.O.S.A.* 22. *pp.* 496–498, *Sept.*, 1932.—It is shown that Uhler's treatment of the theory of plane transmission gratings [see Abstract **3773** (1931)] may be extended and simplified. An inquiry is made into the effect of making the angle of incidence small, and treating it as if it were actually zero. It is shown that the approximation is permissible, and that it is only necessary to use a Gauss eye-piece enough to ensure that the angle i is sufficiently near to zero, and then measure the double angle of diffraction (or deviation), whereupon the calculation of the wave-length takes on a simpler form. A. H.

4937. Hydrogen Discharge Tube for the Continuous Ultra-Violet Spectrum. H. C. Urey, G. M. Murphy and J. A. Duncan. *Rev. Sci. Instruments,* 3. *pp.* 497–498, *Sept.*, 1932.—The tube described differs somewhat from others recently described. It is built of glass (quartz only being employed for the windows), and the cooling is so efficient that currents as high as 2 amperes may be carried for long periods. Being very compact, the tube is easily transferred from place to place. A. H.

4938. Wedge Photometer for Daylight Factor Measurement. D. R. Barber. *Phil. Mag.* 14. *pp.* 404–415, *Sept.*, 1932.—Description and theory of an instrument for evaluating the daylight factor based on the fact that a critical illumination is necessary to enable a detailed object to be just resolved. G. C. McV.

4939. Use of the Radiometer as a Registering Microphotometer. S. Smith and O. C. Wilson, Jr. *Astrophys. J.* 76. *pp.* 117–123, *Sept.*, 1932.—A registering microphotometer is described in which a radiometer is used as the light-sensitive element. The instrument has been made as simple as possible without sacrifice of performance, and tests seem to show that it is both fast and precise, besides being very easy to operate. The details of construction are discussed and some typical records are reproduced. AUTHORS.

4940. Method of Recording Microphotometric Curves. G. Bolla. *N. Cimento*, 9. *pp.* 224–226, *July*, 1932.—The paper describes a method of eliminating the serrations which occur in the record given by a microphotometer which traverses a spectrum or a set of interference fringes on a photographic plate. The essence of the method is to oscillate the lamp of the microphotometer fairly rapidly in a direction perpendicular to that in which the plate is traversed. Thus the intensity of a line or fringe is averaged along its length, since the galvanometer cannot respond to the very rapid fluctuations in intensity along the line. A photograph of a set of Fresnel fringes registered with a type " A " Moll instrument with and without this modification is shown. J. H. A.

4941. Mechanical Equivalent of Light. H. Krefft and M. Pirani. *Zeits. f. techn. Physik*, 13. 8. *pp.* 367–369, 1932.—Describes experiments carried out with the object of exploring the possibilities of determining the mechanical equivalent of light by means of a gaseous discharge tube, actually a sodium tube. Nearly all the light from this source is emitted in the two yellow lines, but there is a small percentage at $\lambda = 5685$ which can be filtered out by means of a copper-sulphate filter. The energy emitted from the combination of lamp and filter can be measured by a thermopile and the light by means of a photometer. The value obtained in the preliminary work described in the paper is 690 lumens per watt. J. W. T. W.

4942. Standardisation of Photographic Negative Materials. R. Luther. *Zeits. f. wiss. Phot.* 31. *pp.* 83–95, *July*, 1932.—Discusses the proposal of the German Committee on Photographic Sensitometry that the speed of negative materials be measured in terms of the exposure required to produce a density 0·1 in excess of the fog value. Since the practical measure of speed is influenced by considerations of the reproducibility of both high-light and shadow detail in the positive, no single arbitrary convention applied to different classes of negative material can give results in complete conformity with " practical " observations. The proposed method is claimed to give a figure superior to the " *Schwellenwert*," or threshold speed, and comparing favourably with Jones' speed at slope 0·2. Exposure, development and densitometry must be carried out under standard conditions, which are fully specified, except that an indefinite " optimal " development time is prescribed. Consistency of the results from three laboratories is discussed. L. V. C.

4943. Borax Developer for Kinematograph Film. A. M. Gundelfinger. *Frank. Inst., J.* 214. *pp.* 223–236, *Aug.*, 1932.—With Carlton and Crabtree's " fine-grain " borax developer containing elon (metol), hydroquinone, borax and sulphite, γ is related to concentrations of the reagents as follows: (i) $\gamma = K_1 \log E + C_1$ (elon concentration varied, and with it the borax); (ii) $\gamma = K_2 \log H + C_2$ (hydroquinone concentration varied);

(iii) $\gamma = K_3 \log E + K_4 \log E \,.\, \log H + K_5 \log H + C_3$ (elon and hydroquinone concentrations varied, and with them the borax). E and H are elon and hydroquinone concentrations, and K_1, . . . etc. and C_1, . . . etc., are constants. L. V. C.

4944. Measurement of Graininess. S. D. Threadgold. *Phot. J.* 72. *pp.* 348–351; *Disc.*, 351, *Aug.*, 1932.—Existing methods estimate "graininess" directly, usually by investigating at what magnification of a developed photographic deposit the latter takes on a "grainy" appearance; they rely much upon personal judgment and occasion eye-strain. On the basis that the factors (*e.g.*, presence and aggregation of grain-clumps) which affect graininess will also affect light scatter, the present method measures graininess as $10D_p/D_d$ at $D_d = 0 \cdot 5$, D_p and D_d being the densities of the photographic deposit with respect to parallel and to completely diffuse light respectively. A comparison method employing a photoelectric cell is described. Graininess in a given material varies with the density at which it is observed; hence the stipulation of an arbitrary D_d datum. The method gives results on negative materials comparable with those afforded by visual direct methods, but breaks down with positive transparencies. In the latter, visual graininess arises from groups of individual grains rather than from clumps, with a different effect on scatter, and hence on D_d. L. V. C.

4945. Applicability of Tungsten Vacuum Lamps to Photographic Sensitometry. W. Dziobek. *Zeits. f. wiss. Phot.* 31. *pp.* 96–104, *July*, 1932.—The standard colour-temperature is 2360° K., and essential data are the corresponding voltage, current and candle-power, the constancy of these during the life of the lamp and their reproducibility. Three definitions of colour-temperature are given; that chosen for sensitometry on account of ease of application is "that temperature at which a black body emits radiation giving the same colour sensations" as the lamp studied. Calibration of a tungsten vacuum lamp in the red, green and blue regions gives results to ± 5° K.; 10° K. corresponds, for an ordinary orthochromatic plate, to 0·5 % change in actinic intensity of the radiation, and this corresponds to a change in voltage of 0·4 %. These lamps behave constantly if aged for 80–100 hr. and their candle-power does not fall more than 1 % in the next 100 hours. The effect on colour-temperature of cooling due to filament supports is negligible. L. V. C.

4946. Sensitisation of Ordinary Photographic Plates to Wave-Lengths Below 2500 Å. A. J. Allen and R. G. Franklin. *J.O.S.A.* 22. *pp.* 469–476 *Sept.* 1932.—The characteristics of and procedures for using a number of substances which will sensitise photographic plates to ultra-violet light below 2500 Å. have been described. Some are water soluble and of fine grain and therefore are adapted to work requiring resolution of detail. Some are soluble only in certain organic solvents. Their crystals are usually somewhat larger and their sensitising power slightly greater. Spectrograms taken with the aluminium spark and with the hydrogen arc show the increased sensitivity of plates sensitised with six of these substances as compared with an unsensitised plate. Densitometer curves, taken with a Kraus densitometer, also show these results in another form. AUTHORS.

4947. Simplified Method of Preparing Schumann Plates. J. J. Hopfield and E. T. S. Appleyard. *J.O.S.A.* 22. *pp.* 488–495, *Sept.*, 1932.—A technique for preparing durable Schumann plates is described,

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enabling them to be prepared with comparative ease. A new method of supersensitising and various technical points relating to their handling are summarised. AUTHORS.

4948. Origin of the Autochrome Plate. L. Gimpel. *Soc. Franç. Phot. et Ciné, Bull.* 19. *pp.* 176–184, *Sept.*, 1932.—Briefly describes the various stages in the manufacture of the autochrome plate, illustrating the difficulties which were successfully overcome by A. and L. Lumière. The glass plate after being covered with a sticky glaze is coated with stained potato starch grains which are limited in size to approximately 1/100 mm. This coating is only 1 grain thick, but it contains three different colours, some grains being stained orange, some green and others violet. The microscopic spaces between the grains are filled with a powder of vegetable carbon which is reduced to a minimum by rolling the plate. Before covering this trichromatic layer with a panchromatic emulsion, it is coated with a varnish in order to protect it during development and fixing. During exposure it is necessary to use an orange-yellow filter, and after development it is better to invert the image and thus obtain the positive. The advantages of the irregular grain distribution over regular distributions are emphasised, whilst mention is also made of the colour film now produced on the same principles. R. C. F.

4949. Calculation and Production of Ortho-Actinic Radiation. H. Bertling. *Zeits. f. wiss. Phot.* 31. *pp.* 107–124, *Sept.*, 1932.—Considers first the fundamental formulæ for the estimation of ortho-actinic radiation, and then gives a table whereby it is possible to calculate the absolute energy values of monochromatic radiation between wave-lengths of 4000 and 7200 Å. The values in the table are based upon the figures obtained by Brodhun and Hoffmann, and Ives, for the mechanical equivalent of light, and are corrected for the variations of the sensitivity of the eye between the above wave-length limits. The production of such radiation is then dealt with, this being most suitably produced by means of combining, in an additive manner, the radiations from gas-discharge tubes of differing emission characteristics. The photometric characteristics of a number of these gas tubes are dealt with and their uses in photographic processes are discussed. R. C. F.

4950. Destruction of the Latent Image with Monochromatic Light. J. Narbutt. *Zeits. f. wiss. Phot.* 31. *pp.* 146–151, *Sept.*, 1932.—Examines the effect of monochromatic light from various regions of the visible spectrum upon plates previously illuminated with white light, and, in certain cases, desensitised. Diapositive plates illuminated with white light, desensitised with pinakryptol-yellow, and then illuminated with violet, blue, green, yellow and red light, all showed a destruction of the latent image, which became more pronounced as the time of exposure to the monochromatic light was increased, although red light did not produce quite such marked effects as the others. Increasing the time of the initial exposure to white light did not affect the final results. The desensitiser also produces a destruction of the latent image, the amount of which is dependent upon the time of development, but this effect is apparently removed by washing after the second illumination, and then giving the plate a third exposure. By means of masking the plates and exposing them to different periods of initial illumination, as well as illumination after desensitisation, it is shown that increasing times of after-illumination result in increased destruction of the latent image, irrespective of the colour of the monochromatic light, the effects being unaccompanied by solarisation. R. C. F.

4951. Measurement of the Density of a Small Spot on a Photographic Plate with a Photoelectric Apparatus. C. Jausseran. *Rev. d'Optique*, 11. *pp.* 337–345, *Sept.*, 1932.—The author discusses, with special reference to the recording microphotometer of Chalonge and Lambert, the sources of error and their elimination, in measuring the density of small spots on photographic plates, when the recording system is a photoelectric cell, amplifier and galvanometer. The points dealt with are the following: electrical stability, proportionality between light flux collected by the cell and the indication of the galvanometer, colour of the light, elimination of parasitic light, adjustment and mounting of the photographic plate. Spots of diameter down to 100 μ and densities between 1 and 3 are contemplated, and with the author's modified apparatus the density is determinable to ± 0·01 or ± 0·02. W. S. S.

4952. Infra-Red Photography. G. Mönch and H. Willenberg. *Zeits. f. Physik*, 77. 3–4. *pp.* 170–173, *July* 26, 1932.—An improved technique for infra-red photography according to the Czerny process. The hydrocarbon $C_{14}H_{20}$ is used on the plates together with blackening by Bi vapour. J. E.

4953. Fluorescence of a Stream of Zinc Atoms. P. Soleillet. *Comptes Rendus*, 195. *pp.* 372–373, *Aug.* 1, 1932.—In a previous note [see Abstract 2437 (1932)] the author gave the results obtained by exciting Cd atoms by means of resonance radiation. Analogous results are now given for Zn; the corresponding radiations are 3076 and 2139 Å. A reason is given for the absence of fluorescence in the case of the line 3076 Å. It is concluded that the state 2^1P_1 for Zn is very unstable, having a life of $\leq 10^{-7}$ sec., and that in the case of the state 2^3P_1 there is no evidence against a longer life than 10^{-5} sec. as is required by polarisation considerations. H. L. B.

4954. Band and Line Fluorescence in Sodium Vapour. A. Jablonski, P. Pringsheim and R. Rompe. *Zeits. f. Physik*, 77. 1–2. *pp.* 26–34, *July*, 1932.—The blue-green and red fluorescence bands excited in Na vapour at 300° C. by white light are equally weakened by addition of N_2 but only about half as much as the D lines which are excited at the same time. By monochromatic excitation with a line in the blue-green absorption region the D line is faintly excited at 400° C. but not at all at 300° C. By addition of a small amount of a foreign gas such as He, A or N_2 the D lines come out strongly but the resonance series is weakened. This effect is connected with the dissociation of the excited molecule by collisions. J. E.

4955. Polarisation of Fluorescent Bands of Cadmium Vapour. L. Sosnowski. *Comptes Rendus*, 195. *pp.* 224–226, *July* 18, 1932.—The van der Lingen bands are found to be partially polarised in a plane determined by the direction of observation and the direction of the exciting light. The maximum polarisation is obtained when the electric vector of the exciting light is perpendicular to this plane, reaching a value of 11 %. The degree of polarisation is found to be independent of temperature between 560 and 800° C. There is no trace of polarisation in the

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visible bands. The fact that the fluorescence of the same wave-length as the exciting light is polarised to the same extent and not more than the bands indicates that the former cannot be Rayleigh diffusion. J. E.

4956. Absorption and Fluorescence Spectra of Mercury Halide Vapours. K. Wieland. *Zeits. f. Physik*, 76. 11–12. *pp.* 801–813, *July* 12, *and* 77. 3–4. *pp.* 157–165, *July* 26, 1932.—By radiating HgI_2 vapour with light corresponding to one of the three short-wave absorption continua a fluorescent spectrum is obtained associated with the following equation: $HgI_2 + h\nu_a = HgI^* + I$, $HgI^* \rightleftarrows HgI + h\nu_f$ where $h\nu_a - h\nu_f \geq Q_1$ (dissociation energy of $HgI_2 \rightarrow HgI + I$). The long-wave continuum with which no fluorescence is associated is attributed to the action $HgI_2 \rightarrow HgI + I$ in opposition to the assumption of Butkow that the products are unexcited. Similar results are obtained for $HgCl_2$ and $HgBr_2$ with the general conclusion that the molecule HgX_2 must be regarded as an atom-molecule. A similar suggestion is made with regard to CdI_2. **Errata,** *ibid.*, 77. 9–10. p. 702, Aug. 24, 1932. J. E.

4957. Resonance Fluorescence of Benzene Vapour. G. B. Kistiakowsky and M. Nelles. *Phys. Rev.* 41. *pp.* 595–604, *Sept.* 1, 1932. —Using the 2536 Hg line the phenomena have been studied in the pressure limits 25 – 0·01 mm. At the lowest pressures the spectrum consists of groups of narrow lines whose spacing indicates transitions from a definite vibration level to various vibration levels of the normal state. The following vibration frequencies of the normal molecule have been identified: 160, 793 (uncertain), 988, 1200, 1354, 1663, and 3139 $cm.^{-1}$. The fine structure of the line groups not fully resolved appears to consist in each case of two strong lines with several weaker ones grouped around. The ordinary high pressure fluorescence is interpreted as due to transitions from the lowest excited state or states reached by inelastic collisions of excited molecules. An apparent continuous emission at the long-wave end at high pressures is attributed to decreased intensity of band heads owing to increased moment of inertia in higher vibrational states of the normal molecule and to a crowding of vibrational levels when the total vibrational energy is large. Observations on toluene in which the fluorescence appears to be almost wholly continuous support this view. J. E.

4958. Line Emission and Absorption of Chromium Phosphors. O. Deutschbein. *Zeits. f. Physik*, 77. 7–8. *pp.* 489–504, *Aug.* 6, 1932.— The emission and absorption spectra of Cr phosphors consist of a number of sharp principal lines, weaker subsidiary lines and bands which obey Stokes' law. The principal lines are attributed to a pure electron jump ^4F–^2G of Cr^{+++}, the subsidiary lines to an intramolecular Stark effect on the principal lines and the bands to the superposition of the lattice vibrations on the electron frequencies. The bands show frequencies which agree in the case of Al_2O_3 with Raman frequencies but in other cases these frequencies must be accounted for by a distorted lattice. A term scheme is given for the MgO spectrum. Since complex Cr ions show a similar absorption spectrum to the phosphors it is concluded that the emitting centre is a complex Cr ion in the parent lattice. [See two following Abstracts.] J. E.

4959. Line Emission and Absorption of Chromium Phosphors. O. Deutschbein. *Ann. d. Physik*, 14. 6. *pp.* 712–728, *Aug.* 30, 1932.—A continuation of the author's recently published work [see preceding

Abstract]. A full description is given of the method of preparation and means of excitation by light and kathode rays of a number of Cr phosphors. All the substances which give the red phosphorescence show the same characteristics, *viz.*, principal doublet bounded by symmetrically placed bands and accompanied by subsidiary lines. A close relation exists between the nature of the molecular structure of the ground material and the nature of the spectrum—the simpler structures showing the simpler spectra. All the spectra are shifted some 20 cm.$^{-1}$ to the ultra-violet at liquid air temperature while in some cases new subsidiary lines appear. Pictures and tables are given showing the positions and relative intensities of the bands and lines. The spectra of complicated compounds and the conditions for the manifestation of phosphorescence together with a short interpretation of the spectra are dealt with in a further paper [see following Abstract]. J. E.

4960. Line Emission and Absorption of Chromium Phosphors. O. Deutschbein. *Ann. d. Physik,* 14. 7. *pp.* 729–754, *Sept.,* 1932.—Researches continued on a large number of artificial Cr phosphors and natural minerals containing Cr as phosphorescent activator [see two preceding Abstracts]. It is concluded that Cr can only be incorporated as a phosphorescent activator when it can be introduced isomorphically into the ground lattice either as Cr_2O_3 or as a more complicated molecule. The emission spectra, and as far as possible the absorption spectra, were studied under light and kathode-ray excitation at 20° and −195° C. and the results are given in diagrammatic form and in numerical tables. A Raman spectrum was also obtained with a synthetic corundum giving a Raman frequency of 417 cm.$^{-1}$. The significance of this is briefly discussed. J. E.

4961. Measurements on the Life of Excited Nitrogen Dioxide. O. Heil. *Zeits. f. Physik,* 77. 9–10. *pp.* 563–567, *Aug.* 24, 1932.—Observations of Baxter [see Abstract 1201 (1931)] on the quenching of the fluorescence of NO_2 by collisions are here combined with measurements on the collision widening of absorption lines. Together they lead to the abnormally long life time of 10^{-5} sec. for the excited NO_2 molecule. This long life estimation has been confirmed by direct observation on the straying of the light-giving molecules from the sharply defined central bundle. J. E.

4962. Theory of Fluorescence Quenching. K. Weber. *Zeits. f. phys. Chem.* 19. *Abt.B.* 1. *pp.* 22–29, *Sept.,* 1932.—The quenching of fluorescence by addition of foreign bodies has usually been attributed to physical causes such as collisions of the second kind. Recently Baur has applied his photochemical theory of sensitising to this quenching effect [see Abstract 102 (1932)]. These results on the quenching of the fluorescence of pinakryptol yellow operate against this theory and indicate that the cause of quenching is physical and is closely related to the deformability of the ions. With increasing polarity of the fluorescent substance the concentration quenching is more marked, indicating that the unactivated molecules are playing the part of deactivators. J. E.

4963. Absorption Distribution in Solutions Containing Two Components. K. Weber. *Zeits. f. Phys. Chem.* 19. *Abt.B.* 1. *pp.* 30–34, *Sept.,* 1932.—Measurements on the quenching of the fluorescence of

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quinine sulphate and sodium napthionate by addition of cinnamylidene-malonic acid show that the formula

$$A = J_0 \cdot \frac{l_1c_1}{l_1c_1 + l_2c_2}(1 - e^{l_1c_1p_1 - l_2c_2p_2})$$

represents the light absorption and that the fluorescence intensity at various concentrations is given by this expression multiplied by the factor $e^{-a\sqrt{c_2}}$, where c_2 is the molar concentration of the dissolved substance. The Perrin formula $\phi = \phi_0 e^{-ac}$ for concentration quenching is wide of the experimental mark. The results are taken to indicate that the quenching is due to molecular collisions. J. E.

4964. Quenching of the Fluorescence of Iodine Vapour in Strong Magnetic Fields. J. Genard. *Zeits. f. Physik*, 77. 11–12. *pp.* 791–794, *Sept.*, 1932.—Describes experiments on the influence of strong magnetic fields on the intensities of the rotation doublets and on the intensity distribution in the resonance series which go to show that the field only affects the excited level of the I_2 molecule. The van Vleck formula is not in accord with the results. J. E.

4965. Optical Dissociation of Iodine and Enhancement of Predissociation by Collisions. L. A. Turner. *Phys. Rev.* 41. *pp.* 627–634, *Sept.* 1, 1932.—Optical dissociation of iodine molecules is demonstrated by absorption by the atoms of light of wave-lengths 1830, 1783, 1642, 1618, 1583 and 1515 Å., these being the lines in the region 2100 to 1514 which arise from transitions to the normal state of the iodine atom. This dissociation is produced in iodine-argon mixtures by light of wave-length >5100 Å., which produces only excited molecules immediately upon absorption, so that the atoms presumably result from dissociation produced by collisions. Spectra of electrical excitation and of fluorescence in iodine-argon mixtures show that molecules of higher v' are more effectively quenched, this larger quenching setting in at about $v' = 12$. This suggests that the effect is a sort of predissociation, enhanced by collisions. A possible theoretical interpretation of such an effect is discussed. AUTHOR.

4966. Relation between the Luminosity of Calcium Tungstate and the Energy of the Exciting Electrons. A. Güntherschulze and F. Keller. *Zeits. f. Physik*, 77. 7–8. *pp.* 528–533, *Aug.* 6, 1932.—Using a flicker photometer the author has measured the light emission from a calcium tungstate screen which is bombarded with electrons of 2000 volts energy and finds an efficiency of 0·104 lumen per watt. Taking this as a calibration, the relation between the efficiency and the energy of the electrons is determined from a set of photometer experiments. The emission increases with the energy (to the power 3·75) of the electrons within the region covered by the experiments, 500–5000 volts. If this relation is capable of extrapolation, the efficiency of the above light source should equal that of a gasfilled lamp at a potential of 8200 volts. The power required to heat the emitting electrode is neglected in this estimate. J. E. R. C.

4967. Unusual Candoluminescence of Solid Solutions. E. L. Nichols and Mary A. Ewer. *J.O.S.A.* 22. *pp.* 456–465, *Aug.*, 1932.—Thorium oxide containing praseodymium, terbium or uranium as activators shows a ruddy candoluminescence when heated by direct contact with a flame. The flash-up is associated with emission of heat energy as indicated by a thermoelectric record of the temperature after removal of the flame. In some cases several discontinuities in the cooling curves are obtained. The causes suggested are (1) reduction by flame and oxidation after removal of flame, (2) storing up of hydrogen and its later oxidation, (3) production of suboxides, (4) belated release and oxidation of stored-up hydrogen, (5) crystallographic rearrangement, and (6) storage and subsequent oxidation of cold hydrogen. J. E.

4968. Intensity of Illumination in Spectrographs. O. Oldenberg. *J.O.S.A.* 22. *pp.* 441–455, *Aug.*, 1932.—The intensity of illumination of the spectrum from a concave grating is computed. The customary arrangements are compared of which some correct the astigmatism of the spectral lines. A cylindrical lens in front of the plate, as suggested by Humphreys and Gehrcke, seems to be the only device that increases the intensity without reducing dispersion and resolving power. Thus for a small spectral range a reduction of the time of exposure to 1/24 has been realised without any loss of resolving power. The bearing of the results on the spectra from the grating at grazing incidence (vacuum spectrograph), the plane grating and the prism is discussed. The main results are checked by experiments. AUTHOR.

4969. Standard Lamp with a Line Spectrum. L. S. Ornstein and H. C. Burger. *Zeits. f. Physik,* 76. 11–12. *pp.* 777–779, *July* 12, 1932.—The continuous emitter, usually used as a standard for intensity measurements, has a number of disadvantages, such as low emission in the ultra-violet and disturbance in the weak part of the spectrum by the rest. It is shown that lamps giving line spectra may be used as standards and that they may be calibrated by the use of filters and a standard thermopile. F. S.

4970. Wood's Method of Separating the D-Lines. E. Gaviola and P. Pringsheim. *Zeits. f. Physik,* 78. 3–4. *pp.* 211–219, *Sept.* 21, 1932.—R. W. Wood separated the components of the D-line by means of crossed nicols and a plane-parallel quartz plate. The quartz plate was of such dimensions as to extinguish one component without the other, while the apparatus furnished a large aperture. The authors find that the aperture of the incident beam must not exceed 1°. Otherwise interference patterns are produced. These are illustrated and discussed.

E. E. F. d'A.

4971. Width of the D Lines of Sodium in Absorption. S. A. Korff. *Astrophys. J.* 76. *pp.* 124–133, *Sept.*, 1932.—Spectrograms of the D lines of sodium in absorption, made with a 30-ft. spectrograph, have been measured with a microphotometer. The contours are found to agree with the predictions of classical (radiation damping) theory, removing discrepancies observed in preliminary work and agreeing with Minkowsky's results. The contours show the theoretical variation of opacity with the inverse square of the wave-length distance from resonance, and the variation of width with the square root of the number of atoms in the line of sight. This work is also in agreement with the quantum mechanical theory of Weisskopf and Wigner. The experiment determines a constant $A = 2\pi e^4\lambda^2/3m^2c^4$, and hence yields a new independent value of e^2/m of $2\cdot51 \pm 0\cdot2 \times 10^8$, compared with the accepted value $2\cdot512 \times 10^8$. The effect of foreign gases on the widths was studied, yielding effective "interaction radii" of 7×10^{-8} cm. for the Na-He combination and 2×10^{-7} for Na-H_2. The radius for Na-Na interaction is found to be of the order 10^{-6} cm. A 2·5-m. column of low-density sodium vapour was used to give an approach to astrophysical conditions. AUTHOR.

4972. Infra-Red Absorption Spectrum of Carbon Dioxide. P. E. Martin and E. F. Barker. *Phys. Rev.* 41. *pp.* 291–303, *Aug.* 1, 1932.—The complete infra-red spectrum of CO_2 may consistently be explained in terms of a linear symmetrical model, making use of the selection rules developed by Dennison and the resonance interaction of Fermi. The inactive fundamental ν_1 appears only in combination bands, but ν_2 at 15 μ and ν_3 at 4·3 μ absorb intensely. The 15 μ and 4·3 μ bands are resolved into their constituent bands. The line spacing of 4·3 μ is the same as in the 15 μ band; in each case alternate rotation lines are absent, the J values for the normal state all being even. The computed moment of inertia is $70 \cdot 8 \times 10^{-40}$ gm. cm.^{2} No first harmonic bands appear, either for ν_2 or ν_3, but the second harmonic is observed in each case. The strong pair of doublet bands at 2·7 μ, the bands at 2·0 μ and 1·6 μ and the weak absorption maxima at 9·4 μ and 10·4 μ are interpreted as combination bands. The difference bands ν_1–ν_2 form part of the 15 μ pattern. Certain Raman lines fit precisely into the energy-level diagram obtained from infra-red measurements. J. E. K.

4973. Infra-Red Absorption Spectra of Chlorine and Sulphur Dioxides. C. R. Bailey and A. B. D. Cassie. *Roy. Soc., Proc.* 137. *pp.* 622–640, *Sept.*, 1932.—The infra-red absorption spectra of ClO_2 and SO_2 are spectroscopically and physically alike. The available evidence permits of two possible structures with vertical angles of approximately 60° and 120° respectively, the weight of probability being slightly in favour of the more acute-angled form. E. E. F. d'A.

4974. Absorption Spectrum of Sulphur Trioxide and Heat of Dissociation of Oxygen. A. K. Dutt. *Roy. Soc., Proc.* 137. *pp.* 366–372, *Aug.* 2, 1932.—The absorption spectrum of SO_3 has been investigated between 5000 and 2000 Å. The absorption is continuous, beginning from 3300 Å. and extending to 2600 Å., at which value it ceases, light being again transmitted up to 2300 Å., where again complete absorption begins and continues up to 2000 Å. The heat of dissociation of oxygen has been calculated at 3300 Å. to be 128 k.cal. and, considering the retransmission, the excitation energy of the O atom is 1·65 volts. This amount does not agree with the $^3P - {}^1D_2$ value of Frerich, but supports Henri's figure of 1·7 volts obtained from the predissociation spectra of NO_2. Other methods for obtaining the heat of dissociation of oxygen are discussed. H. H. Ho.

4975. Absorption Spectrum of HBr and HI. A. K. Datta. *Zeits. f. Physik,* 77. 5–6. *pp.* 404–412, *Aug.* 2, 1932.—The absorption spectra of hydrogen halides consist only of a continuous spectrum with a long-wave limit which Franck has explained on his theory of photochemical dissociation. In view of the influence of gas pressure on the apparent long-wave limit the author has determined an extinction coefficient $\alpha = dI/Idp$, (I = intensity of transmitted radiation, p = pressure), in the range 2000–6000 Å. α is nearly a constant for a given wave-length. By extrapolating the graph of α against λ it is deduced that α should vanish at 3260 Å. for HBr and at 4040 Å. for HI. From these long wave-length limits the corresponding dissociation energies are calculated and indicate the dissociation of the halide molecules into atoms. It is deduced that hydrogen halides are ionic compounds, not atomic compounds of neutral hydrogen and halogen as was previously thought by Franck. J. E. R. C.

4976. Absorption Spectra of the Chromium Ammine Hydrates. R. I. Colmar and F. W. Schwartz. *Am. Chem. Soc., J.* 54. *pp.* 3204–3212, *Aug.*, 1932.—The molecular extinction coefficients, k, of solutions of eleven complex chromammines and cobaltammines have been determined as a function of the wave-length between 4500 and 6300 Å. The k-wave number curves for the Cr and Co salts are parallel and pass through a maximum which is always greater for the Co complexes than for the corresponding Cr complexes. By substitution of a water molecule for one of ammonia the wave number at which k is a maximum is decreased by 610 mm.^{-1}; simultaneously, $k_{\text{max.}}$ decreases in the case of the Cr compounds, but for the Co derivatives the first substitution produces a decrease, and further substitution an increase of $k_{\text{max.}}$. Substitution of ammonia by chlorine decreases the wave number of maximum absorption by 1970 mm^{-1}. A theory of the absorption of complex compounds is developed, and is employed to predict the X-ray crystal structure of such complexes. H. F. G.

4977. Absorption Spectrum of Benzene in the Region of 6·75 μ. S. Silverman. *Phys. Rev.* 41. *pp.* 486–488, *Aug.* 15, 1932.—The absorption band of benzene lying at 6·75 μ has been investigated under high resolution for both liquid and gaseous states. The spectrum for the vapour shows three distinct branches with evidence of unresolved fine structure. The liquid shows a less regular spectrum with a definite shift towards longer wave-lengths. In addition, some new water vapour lines in the 6·26 μ band are reported. AUTHOR.

4978. Absorption Spectra of Substitution Products of Benzene. Part I. Chlorine Series. H. Conrad-Billroth. *Zeits. f. phys. Chem.* 19. *Abt.B.* 1. *pp.* 76–83, *Sept.*, 1932.—The ultra-violet absorption spectra of the chlorine-substituted derivatives of benzene were investigated. The spectra of the chlorbenzenes showed a displacement towards the visible end as the number of substituents was increased. The ortho and meta derivatives behaved in similar ways, but the para derivatives exhibited a characteristic behaviour. By means of the fine structure of the band groups it was possible to estimate the vibration frequencies of the nucleus. The fine structure of the band groups remained practically unaltered throughout the whole series. F. J. B.

4979. Ultra-Violet Absorption Spectra of Solutions Containing Two Chromophoric Groups. A. Hillmer and E. Paersch. *Zeits. f. phys. Chem.* 161. *Abt.A.* 1–2. *pp.* 46–60, *Aug.*, 1932.—The ultra-violet spectra of hexane solutions of benzene, iodobenzene and several aromatic and aliphatic iodides have been measured by the comparison method of Henri. Similar measurements with 50 mol.-% mixtures of benzene with alkyl iodides show that the absorption may be calculated from the absorption spectra of the components; further, the spectrum of phenylpropyl iodide corresponds almost exactly with that of a 50 mol.-% mixture of propyl iodide and propylbenzene. The extinction is thus the sum of the values for the individual chromophoric groups. On passing along the series phenylpropyl iodide, phenylethyl iodide, benzyl iodide, the absorption increases and the bands are displaced towards the longer wave-length end of the spectrum. Henri's rule relating the distance between the chromophores with the absorption is true only as regards the displacement of the bands, and not of the intensity of the absorption; this conclusion is supported by examination of published data relating to ultra-violet absorption spectra. H. F. G.

4980. Splitting of Absorption Spectra at Low Temperature. W. Kasperowicz. *Zeits. f. Physik*, 76. 7–8. *pp*. 481–482, *June* 20, 1932.—It has been noticed that as the temperature is lowered the absorption spectra of various compounds in the ultra-violet split into two, a strongly modified one of lower frequency and a little modified one of almost constant frequency. This occurs at about 2700 Å. F. S.

4981. Rotation-Oscillation Spectrum of Acetylene. K. Hedfeld and P. Lueg. *Zeits. f. Physik*, 77. 7–8. *pp*. 446–458, *Aug*. 6, 1932.—The band spectrum of acetylene has been photographed between 11,000 and 5000 Å. using large dispersion and gas layers up to 24 m. long. Eight absorption bands were found at 10,372, 10,166, 9600, 8617, 8483, 7886, 6408 and 5425 Å. and have been analysed. F. S.

4982. Long-Wave Part of the Visible Spectrum of Light from the Night Sky. L. A. Sommer. *Zeits. f. Physik*, 77. 5–6. *pp*. 374–390, *Aug*. 2, 1932.—Observations were made in 1928–1929 at Göttingen, Flagstaff (Arizona) and Pasadena, the latter being more suitable places, with an extremely well-illuminated spectrograph of the very weak light from the night sky. Lines and bands were identified as those due to O, O_2 and H_2O. The lines of the OI spectrum correspond to the transition between the deep-seated metastable terms $2p\,^3P_{210}$, $2p\,^1D_2$ and $2p\,^1S_0$. The bands of the O_2 spectrum were indicated as quadripole radiation between the deep-seated metastable electron terms $^3\Sigma_g^-$, $^1\Delta_g$ and $^1\Sigma_g^+$ of the spectrum in a similar way to the coordination of quadripole radiation between the deep-seated metastable terms ^3P, ^1D and ^1S of the spectrum of OI and the spectrum transition $^3\Sigma_g^-$ to $^1\Sigma_g^+$. This classification is supported by (1) the agreement of long-wave structure between the emission bands observed here and the atmospheric absorption bands of O_2, (2) the very low absorption coefficient of atmospheric O_2 bands and the quadripole radiation of OI, (3) the difficulty of excitation of this radiation of O_2 and OI in emission, and (4) the low excitation potential, 4·17 volts for $^1S_0$ of OI and 1·62 volts for $^1\Sigma_g^+$ of O_2. The H_2O bands are indicated as due to molecules in rotation. It is confirmed that the terrestrial lines in the Fraunhofer spectrum are identical with those emission lines in the spectrum of the light from the night sky, the solar radiation absorbed by the atmosphere being thus emitted at night. The maximum excitation of the bands was interpreted as radiation products associated with the nocturnal decrease of O_3 in the upper atmosphere. This gives for the lower limit of the upper atmospheric layer in which the night sky functions as 50 km. Comparison of measurements of wave-length with the long-wave part of the auroral spectrum gives agreement of the wave-length structure but large deviations of intensity. The interpretation of the long-wave spectrum of light from the night sky includes an analysis of the corresponding auroral spectrum. R. S. R.

4983. Infra-Red Arc Spectra Photographed with Xenocyanine. W. F. Meggers and C. C. Kiess. *Bureau of Standards, J. of Research,* 9. *pp.* 309–326, *Sept.*, 1932.—A new sensitising dye, xenocyanine, has made possible the preparation, by the Eastman Kodak Co., of plates highly sensitive to infra-red light ranging in wave-length from 8000 to 11,000 Å. With such plates the infra-red arc spectra of about 50 elements have been observed at the Bureau of Standards. New wave-length measurements have been made for Ti, Fe, Co, Ni and Zr, and are presented in this paper. Many of these new lines have been accounted for as combinations between previously known terms of the neutral atoms. In the case of Ti a new term, a^5D, has been found. Both Ti and Fe are rich in strong lines in the region investigated and are recommended as suitable comparison spectra for the measurement of wave-lengths in the infra-red. AUTHORS.

4984. Series and Term Values in the Arc Spectrum of Tellurium. J. E. Ruedy. *Phys. Rev.* 41. *pp.* 588–594, *Sept.* 1, 1932.—Tellurium was excited in an electrodeless discharge tube in such a manner that the arc lines could be distinguished from the spark. The spectrum was photographed in the visible and infra-red, and series were found corresponding to those given in Fowler's *Report on Series in Line Spectra* for the first three elements of the oxygen group. From the limit thus established, which is the lowest level of TeII ($5p^3 : {}^4S_{3/2}$), term values are given down to the lowest level of TeI ($5p^4 : {}^3P_2$). The ionising potential is found to be 72,667 cm.$^{-1}$ or 8·96 volts. A list of the wave-lengths of all the stronger lines, in addition to those classified, is given. AUTHOR.

4985. Arc Spectrum of Arsenic. A. S. Rao. *Phys. Soc., Proc.* 44. *pp.* 594–607, *Sept.* 1, 1932.—By photographing the spectrum of arsenic by the method of the hollow-kathode discharge in helium and in neon about 100 new lines have been recorded. In the light of the experimental data, the analysis of AsI published by previous investigators has been considerably altered and extended. Several new levels have been added and the higher members of the chief groups of the *ms* series of terms have been identified. A mean value of 85,000 cm.$^{-1}$ has been suggested for the deepest term $4p^4S_2$ which leads to a first ionisation potential of approximately 10·5 volts for arsenic. [See Abstract 1462 (1930).] AUTHOR.

4986. Spark Spectrum of Arsenic. M. Ram. *Indian Journ. Phys.* 7. *pp.* 299–305, *Sept.* 1, 1932.—Accurate data for the spark spectrum of arsenic, which have so far been lacking, are provided in the visible and near ultra-violet regions. In all about 130 lines have been measured, most of which are new. The experimental arrangements suggest that the lines are probably due to singly ionised arsenic. AUTHOR.

4987. Second Spark Spectrum of Neon, NeIII. T. L. de Bruin. *Zeits. f Physik,* 77. 7–8. *pp.* 505–514, *Aug.* 6, 1932. *K. Akad. Amsterdam, Proc.* 35. 6. *pp.* 819–826, 1932. *In English.*—The spectrum was strongly excited in a Geissler tube and photographed between 3000 and 2000 Å. by means of a Hilger E1 quartz-spectrograph. Several new lines have been measured and 85 lines between 2825 and 2086 Å. classified. F. S.

4988. Determination of Transition Probability 2P – 1S of Sodium by Absolute Intensity Measurements of Flames. E. F. M. van der Held and L. S. Ornstein. *Zeits. f. Physik,* 77. 7–8. *pp.* 459–477, *Aug.* 6, 1932.—A direct determination of transition probabilities is made by comparing the light intensity of a flame with absolutely calibrated light sources. The sources of error in previous experiments are determined and suitable corrections applied. The transition probability 2P − 1S for Na is found to be $0\cdot 62 \times 10^8$ sec.$^{-1}$; the theoretical classical and wave-mechanical values are $0\cdot 639 \times 10^8$ and $0\cdot 623 \times 10^8$ sec.$^{-1}$ respectively, but the experiment is not sufficiently accurate to enable a decision to be made between the correctness of these two values. J. E. K.

4989. Spectra of NaII, III and IV in the Extreme Ultra-Violet. B. B. Vance. *Phys. Rev.* 41. *pp.* 480–485, *Aug.* 15, 1932.—New lines of NaII, III and IV have been found and classified in the region between 434,000 and 242,000 cm^{-1}. AUTHOR.

4990. Excitation Function of Helium. J. H. Lees. *Roy. Soc., Proc.* 137. *pp.* 173–186, *July* 1, 1932.—The intensities of spectral lines emitted by atoms after collision with electrons are measured photographically. A complete cross-section of the beam is photographed; this allows the integration of the total beam intensity and makes it possible to detect diffuse light background. The variation of light intensity with electron current and helium pressure is measured. Some lines are emitted from points distant from the electron beam, and show anomalous intensity-pressure curves. An estimate is made of the absolute probability of excitation to certain states. [See following Abstract.] A. C. M.

4991. Excitation Processes in Helium. J. H. Lees and H. W. B. Skinner. *Roy. Soc., Proc.* 137. *pp.* 186–198, *July* 1, 1932.—When a defined beam of electrons is passed through helium at a low pressure, it is found that the lines ($2^1S - n^1P$) and ($2^3P - n^3D$) spread considerably outside the electron beam. The spreading of the former is attributed to absorption of the corresponding resonance lines ($1^1S - n^1P$) by the gas, while the spreading of the latter is ascribed to a collision process, $He(n^1P) + He(1^1S) = He(1^1S) + He(n^3D)$, which involves only a small energy transfer. Corresponding anomalies in the intensity-pressure curves and excitation curves for these lines are also interpreted in this way. A rough quantitative picture of the ionisation process in helium is given. [See preceding Abstract.] A. C. M.

4992. Intensity Ratios in Helium Spectrum with Superposition of Canal Ray Motion and Electric Field. H. Kirschbaum. *Ann. d. Physik,* 14. 4. *pp.* 448–462, *Aug.* 1, 1932.—Measurements were made of the intensity ratios in the helium spectrum under three different conditions, (*a*) with electric field in the same direction as the canal rays; (*b*) with electric field in the opposite direction to the canal rays and (*c*) with the electric field at right angles to the canal rays. The field strengths were in all three cases about 143 kV/cm. The results are tabulated. In arrangements (*a*) and (*b*) the intensity ratio for the different helium lines investigated was found to vary between the values $0\cdot 63$ and $1\cdot 75$. The variations are too large to be attributed to experimental errors and it therefore appears that the relative intensity in the two cases is different. The results for arrangement (*c*) are again different from those for (*a*) and (*b*). The following results were obtained for the ratio of intensity of the component displaced towards the red and of that displaced towards the violet in the case of the lines of wave-lengths 4922 and 4388 Å.: I_r/I_v = (*a*) $0\cdot 77$, (*b*) $1\cdot 69$ and (*c*) $1\cdot 12$ for 4922 Å.; I_r/I_v = (*a*) $0\cdot 57$, (*b*) $1\cdot 43$ and (*c*) $1\cdot 09$ for 4388 Å. The intensity ratio of the red and violet components thus appears to be definitely less than unity for arrangement (*a*), and greater than unity for arrangements (*b*) and (*c*), the ratio being, however, less for (*c*) than for (*b*). In all three cases the intensity ratio is lower for the line 4388 Å. This intensity dissymmetry, shown here by lines belonging to both the diffuse subordinate series of He, is analogous to that observed by Stark and by Mark and Wierl in the components of H lines displaced in an electric field. A. W.

4993. Excitation of Continuous and Line Spectra of Helium. J. S. Townsend and M. H. Pakkala. *Phil. Mag.* 14. *pp.* 418–431, *Sept.*, 1932.—Experiments to measure the changes in intensities of the continuous and line spectra of helium due to changes of pressure in the discharge tube. Both spectra are attributed to the collisions of electrons with atoms of the gas and a calculation is made of the mean energy of electrons which excite the continuous spectrum and that of the electrons exciting the line spectrum. G. C. McV.

4994. Band Spectra. E. Rabinowitsch. *Zeits. f. Elektrochem.* 38. *pp.* 370–387, *June, and pp.* 451–464, *July*, 1932.—A continuation of the preceding paper [see Abstract 3437 (1931)] on band spectra. The third section deals with the electron spectrum and the theory of the structure of the molecule. Further references to papers which have appeared since the previous paper are given The concluding section deals with the theory of the rotation spectrum in a similar way to that in which the electron and oscillation spectra have been treated. F. S.

4995. Band Spectrum of Zirconium Oxide. L. W. Johnson. *Phil. Mag.* 14. *pp.* 286–291, *Aug.*, 1932.—The band spectrum of zirconium oxide has been photographed in the first order of a 21-ft. grating. Whilst the work was in progress F. Lowater [see Abstract 1979 (1932)] published an analysis of this spectrum. The results obtained in the present work agree with those of Lowater. Tables of wave-lengths are given. A. H.

4996. Intensities in N_2 α- and NO β-Bands. F. Cavalloni. *Zeits. f. Physik*, 76. 7–8. *pp.* 527–534, *June* 20, 1932.—The intensities of the N_2 α-bands between 6700 and 5300 Å. and of the NO β-bands between 4900 and 2700 Å. were measured photographically. A. C. M.

4997. Perturbations and Rotation Constants of Some First Negative Nitrogen Bands. W. H. J. Childs. *Roy. Soc., Proc.* 137. *pp.* 641–661, *Sept.* 1, 1932.—The first negative nitrogen bands as excited by a low voltage arc in nitrogen at 10 cm. pressure are examined under high dispersion. The rotational structure of the (0,0) and (0,1) bands is studied and various constants evaluated. Perturbations are observed and found to be related to those already observed in other bands. It is assumed that a $^2\Pi$ term is responsible for the perturbations and estimates of the position of this level are made. A. H.

4998. Analysis of the (0,0) $^2\Pi \rightarrow {}^2\Sigma$ CN Band at 9168 Å. A. E. Parker. *Phys. Rev.* 41. *pp.* 274–277, *Aug.* 1, 1932.—The rotational structure of the 0,0 band of the red CN system has been analysed by means of spectrograms taken in the first order of a 21-foot grating. The values obtained for the various constants are $B_0'' = 1\cdot8906$ cm.$^{-1}$, $B_0' = 1\cdot6907$ cm.$^{-1}$, $D_0' = -6\cdot07 \times 10^{-6}$ cm.$^{-1}$, $A = -53\cdot3$ cm.$^{-1}$, $p_0 = 0\cdot009$ cm.$^{-1}$ and $q_0 = -0\cdot0008$ cm.$^{-1}$. These are in agreement with the values obtained by Jenkins, Roots and Mulliken [see Abstract 1982

(1932)] for transitions which involve higher vibrational levels of the $^3\Pi$ state. The origin of the band is at 10,905·12 cm.$^{-1}$. AUTHOR.

4999. Double Band in Solid Hydrochloric Acid. G. Hettner. *Zeits. f. Physik,* 78. 3–4. *pp.* 141–155, *Sept.* 21, 1932.—A double band was found in solid HCl at 87° Abs. at the same position as the band in gaseous HCl. At 20° Abs. the long-wave portion of this band vanishes. Possible explanations are discussed, from which it appears likely that there is still some rotation of the molecule in solid HCl. F. S.

5000. Rotational Analysis of Some CO_2 Emission Bands. Part I. R. F. Schmid. *Phys. Rev.* 41. *pp.* 732–750, *Sept.* 15, 1932.—By using the light of a hollow kathode discharge and that of a Back box with direct current, the red degraded CO_2 bands at λλ3247, 3254, 3370, 3377, 3503, 3511, 3534, 3545, 3674 and 3839 Å. have been photographed in the third order of a 21-foot Rowland grating and analysed. The bands are composed of P and R branches and on first inspection they show no alternately missing lines. The lines of the bands at λλ3254, 3377, 3511, 3534, and 3839 Å. show staggering, while the lines of the other bands do not (in the limit of observational accuracy). The single structure of the bands indicates that the molecule is linear in both initial and final states. The distance between the carbon and an oxygen atom computed from the rotational constants is almost the same as computed from the CO and CO^+ bands. The above enumerated bands show no Zeeman effect of the observable lines. Other bands which are found to show more complicated structure and Zeeman effect will be the subject of further investigations. AUTHOR.

5001. Boltzmann Distribution in the Hydrogen Spectrum. L. S. Ornstein and A. A. Kruithof. *Zeits. f. Physik,* 76. 11–12. *pp.* 780–781, *July* 12, 1932.—It is shown that when hydrogen is excited by electron impact, the excited states in the $AR_2 1 \cdot 0$ band follow a Boltzmann distribution. The temperature determining the distribution is approximately room-temperature and varies with the current density. F. S.

5002. Molecular Spectra. R. C. Johnson and N. R. Tawde. *Roy. Soc., Proc.* 137. *pp.* 575–591, *Sept.* 1, 1932.—Discusses the sources of error in photographic spectrophotometry over wide ranges. It is generally desirable to fog the plate on to the linear part of the characteristic curve. Peak intensities of the "Swan" system of the C_2 molecule were measured from calibrated photographs of the spectrum, and the vibrational transition probabilities compared with the Condon "parabola" of maximum probability, which was derived from Morse's formula. E. E. F. d'A.

5003. Molecular Spectra and Intramolecular Forces. Part I. G. Jung and H. Gude. *Zeits. f. phys. Chem.* 18. *Abt.B.* 6. *pp.* 380–400, *Sept.,* 1932.—This paper is concerned with the N–H bond in gaseous, liquid and dissolved ammonia. The positions of the 4th and 5th overtones of the 3μ band of gaseous NH_3 are determined and the fine structure of the 4th overtone measured. The positions of oscillations in the various states are compared and the influence of solvent discussed. F. S.

5004. Spectra of Imperfectly-Bound Molecules. H. Kuhn. *Zeits. f. Physik,* 76. 11–12. *pp.* 782–792, *July* 12, 1932.—Absorption bands have been found close to the principal lines of alkali vapours. These are attributed to polarised molecules, which must be present in nearly the same quantity as normal ones. A broadening of Cs lines towards long wavelengths has also been observed, attributable to the large polarisation force of this element. The influence of A and N_2 is to be tried. F. S.

5005. Predissociation Spectra of Triatomic Molecules. J. Franck, H. Sponer and E. Teller. *Zeits. f. phys. Chem.* 18. *Abt.B*1. *pp.* 88–101, *July,* **1932.**—Differences of structure of the predissociation spectra of triatomic molecules from those of diatomic molecules are discussed, and explained by complicated motions of the nuclei. In a similar way, the dependence of the diffuse predissociation limit upon temperature is explained. The spectra of NO_2 and SO_2 are discussed in the light of these considerations. F. S.

5006. Vibrational Levels of Linear Symmetrical Triatomic Molecules. D. M. Dennison. *Phys. Rev.* 41. *pp.* 304–312, *Aug.* 1, 1932.—The theory proposed by E. Fermi [see Abstract 455 (1932)] of the energy levels of molecules of the CO_2 type is discussed. It is shown that this assumes a particularly simple form when expressed in the coordinates used by Dennison for describing such molecules. When there exist no integral or nearly integral relations between the vibrational frequencies the first order energy correction λW_1 caused by the anharmonic forces vanishes, leaving only the second order term $\lambda^2 W_2$. When, however, two of the fundamental frequencies are commensurable, certain of the energy levels coincide, thus becoming degenerate. This degeneracy may be removed by the anharmonic forces, in which case there appears a first order energy constant λW_1 different from zero. The value of λW_1 is computed explicitly for certain of the lower energy states and it appears that the only levels which interact under the influence of the resonance are those having the same value of the azimuthal quantum number *l*. From this it follows that the selection rules are not affected by the existence of the resonance. Finally it is shown how the first order term λW_1 goes over into the second order term $\lambda^2 W_2$ as the resonance between the frequencies becomes less and less exact. When these results are applied to the CO_2 spectrum it is found that the resonance between ν_1 and $2\nu_2$ is almost perfect and consequently the energy levels can only be ordered with the help of the first order term λW_1. For CS_2, on the other hand, the difference between ν_1 and $2\nu_2$ is so large that the effect of the resonance on the positions of the energy levels may be disregarded. AUTHOR.

5007. Two-Minima Problem and the Ammonia Molecule. D. M. Dennison and G. E. Uhlenbeck. *Phys. Rev.* 41. *pp.* 313–321, *Aug* .1, **1932.**—The system of a particle moving in a potential field containing two equal minima is treated by the Wentzel–Kramers–Brillouin method of approximation. The energy levels are grouped in pairs and the object of the computation is to find the separation between two levels forming a pair. This is accomplished by connecting the oscillatory and exponential approximate solutions of the wave equation by means of the Kramers connection formulæ. If Δ is the separation of a pair and $h\nu$ the distance between two pairs $\Delta/h\nu = 1/\pi A^2$, where $A = \exp\left[(2\pi/h)\int_0^{x_1}[2m(V - E)]^{1/2}dx\right]$. A particular potential curve is chosen consisting of two equal parabolæ connected by a straight line. The expression for Δ may then be evaluated explicitly as a function of the length of the joining line, $2(x_0 - \alpha)$ and the distance between two minima, $2x_0$. These formulæ may be applied to determining the form of the ammonia molecule. Substituting the experimental values for Δ_0 and Δ_1, it is found that $x_0 = 3 \cdot 161$ and $\alpha = 1 \cdot 916$. An exact solution for this particular potential curve may be found by joining Weber's function $D_n(x - x_0)$ and $D_n(x + x_0)$ to a hyperbolic sine or cosine. This process also leads to expressions for Δ which may be equated to the experimental values yielding $x_0 = 3 \cdot 182$ and $\alpha = 1 \cdot 930$, in good agreement with the earlier determination. Finally x_0 is used to compute $2q_0 = 0 \cdot 760 \times 10^{-8}$ cm., the distance between the two potential minima, and the following dimensions of the ammonia molecule, $H - H = 1 \cdot 64 \times 10^{-8}$, $N - H = 1 \cdot 02 \times 10^{-8}$ cm. AUTHORS.

5008. Extension of Sum Rules for Alkalies. J. G. Kirkwood. *Phys. Zeits,* 33. *pp.* 521–525, *July* 15, 1932.—An alternative method of deducing Wigner's results for the sum rules is given. The theory is applied to the Stark effect for the alkalies. F. S.

5009. Estimation of Spectral Properties of Element 87. H. Yagoda. *Am. Chem. Soc., J.* 54. *pp.* 3074–3080, *Aug.*, 1932.—Evidence is produced which suggests that the spectroscopic properties of element 87 will not follow the same trend as the triad K, Rb and Cs, but that the properties of the singly ionised Ra atom will be much more nearly analogous. A variety of methods is employed for estimating the ionisation potential of element 87 and these agree in indicating the value to be of the order of 4 volts. The doublet separations of the principal series are also estimated, whilst suggestions are made as to the whereabouts of the ultimate lines. A. H.

5010. Radiation from Cæsium and Other Metals Bombarded by Slow Electrons. C. Boeckner. *Bureau of Standards, J. of Research,* 9. *pp.* 413–418, *Sept.*, 1932.—The absolute intensity and intensity wavelength distribution of the radiation from Cs, Cr, Ni, Mo, and W is measured and found to be similar for all five metals. Control measurements are also made allowing the effect of surface contamination to be estimated. It is found that the radiation from contaminated surfaces is usually much more intense than from clean metals. It is pointed out that the similarity between the radiation from cæsium and other metals makes it probable that the radiation is analogous to the continuous X-rays and is not due to the excitation of electron levels characteristic of the metal. [See also Abstracts 2712 (1931) and 952 (1932).] AUTHOR.

5011. Wave-Statistical Theory of Fine-Structure. K. C. Kar and K. K. Mukherjee. *Indian Phys. Math. J.* 3. *pp.* 65–72, *June*, 1932.—The relativistic modification of the wave equations for the electron which the authors have obtained in previous papers, is developed, and the corresponding fine-structure formula is obtained. The latter is found to involve ½-quantum numbers and differs therefore from Dirac's result which agrees with the original Sommerfeld expression and also with experiment. The authors claim, however, that Dirac's analysis contains certain fallacies and that their own result involving ½-quantum numbers is correct. The discrepancy between their result and experiment has then to be sought elsewhere. W. S. S.

5012. Theory of Coupling-Breadth. V. Weisskopf. *Zeits. f. Physik,* 77. 5–6. *pp.* 398–400, *Aug.* 2, 1932. Extension and amendment of previous work [see Abstract 3271 (1932)]. A. D.

5013. Multiplet Splitting and Intensities of Intercombination Lines. Part I. H. C. Wolfe. *Phys. Rev.* 41. *pp.* 443–458, *Aug.* 15, 1932.—A symbolic representation method due to Kramers is applied to configurations involving two valence electrons—one being in an *s* state. This configuration gives rise to a singlet and a triplet with the *l* values of the second electron. Deviations from the normal l to $l + 1$ interval ratio in the triplet are due to repulsion between the singlet level and the centre triplet level, their *j* values being the same. Mixing up of the wave functions of these two levels gives rise to singlet-triplet intercombinations. Constants representing the interaction energies (1) interchange, (2) spin-orbit, (3) spin of one electron-orbit of the other (neglecting other types of interaction) are found in terms of the three intervals of the multiplet. Corrections to the Kronig-Hönl intensity formulæ are made. These formulæ then give the relative intensities of combination and intercombination lines. The sum rules for intensity hold for the complete multiplet and not for the singlet and triplet separately. A. H.

5014. Nuclear Spin of Arsenic. S. Tolansky. *Roy. Soc., Proc.* 137. *pp.* 541–558, *Sept.* 1, 1932.—The hyperfine structures of most of the strong lines in the visible spectrum of AsII are observed and analysed with a Fabry-Perot interferometer. The structures can be explained by taking the nuclear spin of As to be 3/2. Interesting conclusions concerning the electron coupling in the AsII spectrum can be drawn from the analysis of the term structures. The fine-structure observations confirm the gross structure multiplet analysis. J. E. K.

5015. Nuclear Moments of the Lighter Elements. S. Tolansky. *Zeits. f. Physik*, 78. 1–2. *pp.* 71–73, *Sept.* 8, 1932.—Shows that the *g*(I) factors of the odd-numbered atoms between Na and Mn pass through a minimum. This fact depends, apparently, on the manner in which the nucleus is built up out of protons. A connection is shown between nuclear spin and packing-fraction of the lighter elements, the atoms with a small packing-fraction tending to have no nuclear spin. G. G. S.

5016. Nuclear Moment of Barium and Hyperfine Structure of BaII Lines. P. G. Kruger, R. C. Gibbs and R. C. Williams. *Phys. Rev.* 41. *pp.* 322–326, *Aug.* 1, 1932.—The hyperfine structure of the BaII lines 4934 Å. and 4554 Å. is investigated. From the relative intensities and separations of the components it is concluded that if the isotopes Ba^{136} and Ba^{138} have zero nuclear moments the most probable value of the nuclear moment of Ba^{135} and Ba^{137} is $I = 5/2$. The hyperfine splitting of all but the $6s^2S_{1/2}$, $6p^2P_{1/2}$ and $6p^2P_{3/2}$ levels is very small. There is some evidence that there is an isotopic shift of the centre of gravity of the levels of the odd isotopes with respect to the even isotopes. J. E. K.

5017. Hyperfine Structure of Arc and Spark Spectra of Barium. K. Murakawa. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 374. *pp.* 304–314, *Aug.*, 1932.—The hyperfine structure of arc and spark spectra of Ba is investigated with a hollow-kathode discharge. From the experimental data it is concluded that the isotopes Ba^{135} and Ba^{137} have the nuclear moment $I = 3/2$, and the isotopes Ba^{136} and Ba^{138} have nuclear moment $I = 0$. The even isotopes show no isotope displacement effect. The hyperfine structures of the various elements so far investigated are compared. J. E. K.

V. 19

5018. Hyperfine Structure of Mercury. Part VI. K. Murakawa. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 373. *pp.* 299–303, *Aug.*, 1932.—The hyperfine structures of further HgI and HgII lines are analysed. These are the lines 3650, 2464 and 6123 Å. of HgI and the lines 3984 and 6149 Å. of HgII. [For Part V see Abstract 3755 (1932).] J. E. K.

5019. Hyperfine Structures and Nuclear Moments of Mercury. K. Murakawa. *Zeits. f. Physik*, 77. 9–10. *pp.* 699–700, *Aug.* 24, 1932.—Murakawa raises objections to the criticism by Schüler and Jones [see Abstract 2860 (1932)] of his work on the hyperfine structure of mercury and also expresses disagreement with some minor points in the observational data. **Schüler** and **Jones,** *ibid.* pp. 701–702, reply to Murakawa's objections and effectively clear up the contested points. J. E. K.

5020. Perturbation in Hyperfine Structure Terms of Mercury. H. Schüler and E. G. Jones. *Zeits. f. Physik*, 77. 11–12. *pp.* 801–810. *Sept.* 3, 1932.—The hyperfine structures of the HgI terms 6^1D_2 and 6^3D_1 are anomalous with respect to their separations and the positions of the centres of gravity. The suggested explanation of this anomaly is that within an isotope the hyperfine structure levels having the same L and F values mutually repel one another. This effect occurs as a result of the separation of the terms 6^1D_2 and 6^3D_1, being comparable with the hyperfine structure separations. Since the even isotopes do not experience any repulsion effect the perturbations of the uneven isotopes can be exactly determined. The repulsion is not only a function of the separation of the disturbing levels but also depends on the F and I values. This perturbation effect, which can be followed in exact detail, has not been hitherto observed; as a result of it all anomalies shown by the 6 D terms can be given a plausible explanation. [See following Abstract.] J. E. K.

5021. Perturbations in Hyperfine Structures. H. Casimir. *Zeits. f. Physik*, 77. 11–12. *pp.* 811–814, *Sept.* 3, 1932.—It is shown that the results found by Schüler and Jones [see preceding Abstract] are incompatible with the assumption that the interaction between the nucleus and the electron shells is equal to the scalar product of two vectors. J. E. K.

5022. Isotope Shift in Hyperfine Structure. Jenny E. Rosenthal and G. Breit. *Phys. Rev.* 41. *pp.* 459–470, *Aug.* 15, 1932.—The effect of deviations of the nuclear field from the inverse square law such as are suggested by the theory of radioactive disintegration is calculated. The isotope shift due to a change of the nuclear radius by 1 % is found to be larger than those observed. The spectrum of Tl appears not to fit any simple modification of the theory. The isotope shifts in PbI and PbII can be explained roughly on the supposition that the deviations of the nuclear field from the inverse square law are local but that for the valence electrons these deviations should be taken to be smaller than is usually supposed in the theory of radioactive disintegration. AUTHORS.

5023. Isotope Separations in the Infra-Red Absorption Spectrum of HCl and the Possible Existence of a Chlorine Isotope of Mass 39. J. D. Hardy and G. B. B. M. Sutherland. *Phys. Rev.* 41. *pp.* 471–479, *Aug.* 15, 1932.—The absorption band of HCl at 1·7 μ has been re-examined under high dispersion in an attempt to verify the work of Hettner and Böhme [see Abstract 1106 (1932)] on the existence of a third chlorine isotope, Cl^{39}. No trace of the isotope was observed although a path length of 3 m., some ten times the path used by Hettner and Böhme, was used. The isotope separations due to Cl^{35} and Cl^{37} have been measured very accurately and do not agree with the separations calculated by the simple theory. When the anharmonic terms in the energy are taken into account the agreement between the calculated and observed isotope separations is within the experimental error. The isotope separation for HCl^{39} molecule has been calculated and found to be slightly different from that observed by Hettner and Böhme. The results indicate that the relative abundance of Cl^{39} to Cl^{39} cannot be greater than 1 to 500. AUTHORS.

5024. Isotopes and Band Spectra. R. de L. Kronig. *Congrès International d'Électricité, Paris, Sect.* 1. *Rapport No.* 21. [15 *pp.*], 1932.—An outline of the theory of isotope-effect in band spectra with a *résumé* of experimental results. The determination of relative abundance of isotopes from the intensity of band lines is included and also a Bibliography. F. S.

5025. Raman Spectra of Substituted Benzene Products. A. Dadieu, A. Pongratz and K. W. F. Kohlrausch. *Akad. Wiss. Wien, Ber.*, 141. 2*a*. 1–2. *pp*. 113–128, 1932.—The Raman spectra of the following substitution products of benzene are reported: 1 : 3 : 5; 1 : 2 : 6; 1 : 2 : 3; 1 : 3 : 4; 1 : 2 : 5, and 1 : 2 : 4 xylenols and xylidines. These have been investigated with a view to the structure of benzene. It is believed that a trigonal symmetry in benzene is indicated. A. C. M.

5026. Raman Spectra of Isomeric Paraffin Derivatives. A. Dadieu, A. Pongratz and K. W. F. Kohlrausch. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 3–4. *pp*. 267–281, 1932.—The Raman spectra are reported of the following substances: isopropyl-amine, -alcohol, -mercaptan, -chloride, -bromide, -iodide; tertiary amyl-alcohol, -chloride, -bromide; and tertiary butyl-alcohol, -chloride, -bromide, -iodide. CH_3, NH_2 and OH groups can be substituted for one another without marked variations in the Raman spectra (apart from the internal vibrations of the radicals), while introduction of SH, NO_2, Cl, etc. causes a change in the spectrum. Thus in $(CH_3)_3 . CCl$ the $(CH_3)_3C$ portion will possess a three-fold symmetry, but in $(CH_3)_3C . OH$ a higher (four-fold) symmetry analogous to that found in $(CH_3)_4C$ must be sought. This is established almost quantitatively by consideration of the frequencies to be expected in the structures $C(CH_3)_2$, $C(CH_3)_3$, and $C(CH_3)_4$. A. C. M.

5027. Raman Effect in Salt Solutions. A. da Silveira and E. Bauer. *Comptes Rendus*, 195. *pp*. 416–418, *Aug*. 8, 1932.—A number of other solutions have been studied by the method already described [see Abstract 3284 (1932)] and a table of results is given for HCl and chlorides and nitrates of Mg, Ca, Sr, Li, Cd. Evidence is obtained for attributing the frequency 1657 cm.$^{-1}$ to water whose activity is increased by the various kations. This frequency corresponds to the infra-red absorption frequency 1600 cm.$^{-1}$. A frequency 243 cm.$^{-1}$ in $CdCl_2$ is attributed to complex undissociated ions $CdCl_3$. The observations enable the authors to give a partial explanation of the results of Gerlach [see Abstract 4025 (1930)] on the change of the water band with addition of salts. [See also following Abstract.] J. E.

5028. Raman Effect in Salt Solutions. A. da Silveira. *Comptes Rendus*, 195. *pp*. 521–523, *Sept*. 5, 1932.—Continuing previous work [see preceding Abstract] results are given on solutions saturated with NH_4Cl, NH_4NO_3 and $(NH_4)_2SO_4$. In the sulphate solutions, besides the well-known SO_4 frequencies, there are two new ones 553 and 683 which appear to be companions of the known 616. This is considered as a detripling of 616 due to interionic Stark effect. Three frequencies, 1116, 1300 and 1467, which form a triplet are attributed to the NH_4-ion and following the interpretation of Kastler [see Abstract 3469 (1931)] are considered to correspond to the P, Q and R branches of NH_3 gas. In the chloride, three frequencies, 1453, 1300 and 1115, are attributed to NH_4. J. E.

5029. Raman Effect of Aqueous Nitrate Solutions. P. Grassmann. *Zeits. f. Physik*, 77. 9–10. *pp*. 616–631, *Aug*. 24, 1932.—The Raman spectra of the solutions in water of the nitrates of numerous metals were obtained with great dispersion and measured as accurately as possible. The degree of polarisation of the lines was determined. The melted nitrates of K and Li were examined and the results compared with the measurements on solutions and the water-containing solid salts. J. J. S.

5030. Raman Spectra of Iodides. Part I. Phosphonium Iodide and Methyl Iodide. N. G. Pai. *Indian Journ. Phys*. 7. *pp*. 285–298, *Sept*. 1, 1932.—The Raman effect in crystals of PH_4I has been studied with a view to correlating it with the crystal structure of the compound. The frequencies found are 930 (2), 1040 (0), 1113 (0), 1259 (1), 1416 (1), 2304 (10), 2370 (8). All these frequencies are attributed to the ionic group PH_4 found in the crystal, which is assumed to be distorted under the influence of the neighbouring iodine ions. The Raman spectrum of CH_3I liquid has been studied thoroughly, the method of continuous distillation being used to avoid the effect of photochemical decomposition. The following 13 frequencies, of which 5 are reported for the first time, have been established: 524 (8), 895 (1), 1028 (0), 1242 (3), 1434 (1), 1760 (0), 2050 (0), 2461 (1), 2557 (1), 2796 (1), 2849 (1), 2950 (5) and 3050 (3). Allowing for the small diminution of frequency which occurs in passing from the vapour to the liquid state, every one of the Q branches observed in the infra-red absorption of the vapour by Bennet and Meyer [see Abstract 1208 (1929)] has a corresponding Raman line. AUTHOR.

5031. Raman Spectrum Test for Sodium Bisulphite in Solution. P. Fadda. *N. Cimento*, 9. *pp*. 227–230, *July*, 1932.—When a concentrated solution of sodium carbonate is saturated with SO_2, a compound is formed which has sometimes been thought to be $NaHSO_3$ and sometimes $Na_2S_2O_5$. The solid which crystallises was shown in 1924 to contain no $NaHSO_3$. The Raman spectrum has now been examined in the case of the solution. Five lines were found, of which four agree with the Raman lines of $Na_2S_2O_5$. The source of the remaining one is discussed, and it is concluded that it cannot be due to $NaHSO_3$, and hence that $NaHSO_3$ does not exist in the solution. J. H. A.

5032. Raman Effect and Molecular Anisotropy. J. Weiler. *Phys. Zeits*. 33. *pp*. 489–498, *July* 1, 1932.—A review of the theory and the experimental observations made by using the Raman effect. The unmodified scattered line, highly polarised, is accompanied by " wings " which are little polarised. These wings are regarded as rotational Raman lines, and their existence is bound up with a value of the optical anisotropy of the scattering molecules different from zero. A. C. M.

5033. Intensities of Raman Lines. G. Ellenberger. *Ann. d. Physik*, 14. 2. *pp.* 221–240, *July* 12, 1932.—The intensities were measured of a number of homologous lines excited by the mercury lines 4047, 4358 and 5461 Å. in CCl_4, C_6H_6, methylenechloride, tetrachlorethane and acetic acid. The intensities show a departure from the theoretical $(\nu - \nu_i)^4$ law; this departure is the greater the larger the Raman frequency shift (ν_i). The direction of this departure suggests the influence of an ultra-violet absorption region. A. C. M.

5034. Zeeman Effect. P. Zeeman and T. L. de Bruin. *Congrès International d'Électricité, Paris, Sect.* 1. *Rapport No.* 29. [10 *pp.*], 1932.—An outline of the effect with its associated laws and related phenomena. F. S.

5035. Stark Effect. H. R. v. Traubenberg. *Congrès International d'Électricité, Paris, Sect.* 1. *Rapport No.* 30. [18 *pp.*], 1932.—The two principal methods of excitation, due to Stark and lo Surdo respectively, are described, together with the various results obtained. Numerous references are given. F. S.

5036. Stark Effect of Hydrogen Lines. K. Sjögren. *Zeits. f. Physik*, 77. 5–6. *pp.* 290–295, *Aug.* 2, 1932.—An absolute determination of the splitting of Balmer lines in the Stark effect is described. The canal-ray method as arranged by v. Traubenberg and Gebauer [*Naturwiss*, 18. 132. 1930] is used, and results in complete agreement with theory are obtained. J. E. K.

5037. Inverse Stark Effect for Rubidium and Cæsium. Y. T. Yao. *Zeits. f. Physik*, 77. 5–6. *pp.* 307–316, *Aug.* 2, 1932.—Stark effect in absorption has been measured for the second member of the principal series of Rb and Cs. Displacement to the red is shown to be proportional to the square of the field. The 4555 Å. line of Cs shows increased absorption in the electric field. The results are compared with theory. F. S.

5038. Stark Effect in Argon. N. Ryde. *Zeits. f. Physik*, 77. 7–8. *pp.* 515–527, *Aug.* 6, 1932.—Lo Surdo's method was used, and about 150 lines between 8000 and 4200 Å. observed in a field of 115 kV/cm. The effect on A lines is distinctly different from that on Ne lines previously observed. The results are discussed in detail. No effect was found in the case of spark lines of A. F. S.

5039. Stark Effect for Strong Fields. M. A. El-Sherbini. *Phil. Mag.* 14. *pp.* 384–386, *Sept.*, 1932.—Continuation of a previous paper [see Abstract 1992 (1932)]. The third-order terms are calculated by a new method, that of Wentzel. A correction of two equations in the former paper is given. J. J. S.

5040. Production of Infra-Red Spectra with Electric Fields. E. U. Condon. *Phys. Rev.* 41. *pp.* 759–762, *Sept.* 15, 1932.—A substance in a strong electric field acquires a new infra-red spectrum owing to changes in the selection rules. The spectrum is governed by matrix components of the molecular polarisability and hence has the same intensity rules as the Raman effect. AUTHOR.

5041. Velocity of Propagation of Light in a Vacuum in a Transverse Magnetic Field. C. C. Farr and C. J. Banwell. *Roy. Soc., Proc.* 137. *pp.* 275–282, *Aug.* 2 1932.—An experimental attempt is made to determine whether a transverse magnetic field influences the velocity of propagation of light *in vacuo*. An interference method is used, one of the two rays from the first mirror of a Jamin refractometer being passed through a strong magnetic field in the gaps of three electromagnets whilst the other ray passes through a weaker field. The two rays are recombined at a second mirror and the resulting bands viewed with a microscope lens combination. Any relative change in the velocities of the two rays would be observed as a movement of the bands. The optical system is capable of detecting a relative change in velocity of 1 part in 2 × 10^7, or about 14 m. per sec., the sensitivity of the apparatus being considerably greater than that reached by previous experimenters. A null result is obtained. A. H.

5042. Measurement of Velocity of Light. N. E. Dorsey. *Congrès International d'Électricité, Paris, Sect.* 2. *Rapport No.* 10. [18 *pp*.], 1932.—A list is given of the determinations of the velocity of light made since 1878 by the three methods of (1) direct measurement of the velocity, (2) measurement of the ratio of the electrostatic to the electromagnetic unit of electricity, (3) measurement of the velocity of wireless waves. An analysis of the hypotheses underlying the three methods is added.

G. C. McV.

5043. Anomalous Radiographs Obtained with Semi-Conducting Cellules. G. Reboul. *Comptes Rendus*, 194. *pp*. 2304–2305, *June* 27, 1932.—Under the action of semi-conducting cellules paper becomes photographically active. The author points out that radiographs obtained using these cellules are different from those obtained by using X-rays. Notably, radiographs may be obtained at a distance from the source, since the action is due to gases emitted from the cellules. The author has noticed a fatigue effect whereby the radiographs obtained may occasionally be that due to a *previous* exposure. It is also possible to produce a reversed image. [See also Abstract 2885 (1932).] J. E. R. C.

5044. Influence of Screening on the Intensities of X-Ray Lines. J. A. Prins. *Zeits. f. Physik*, 77. 7–8. *pp*. 478–488, *Aug*. 6, 1932.—Systematic differences exist between the observed intensities of X-ray lines and the intensities calculated from the hydrogen model; these differences assume very large values in the region of very soft X-rays. The differences can be explained as due to a difference in the screening between the upper and lower electron orbits, *i.e.*, a non-coulombian atomic field.

J. E. K.

5045. Partial Absorption in the Region of Soft X-Rays. F. C. Chalklin and L. P. Chalklin. *Comptes Rendus*, 195. *pp*. 374–376, *Aug*. 1, 1932.—A lowering of the frequency of certain K_α lines in passing through carbon, nitrogen and aluminium has been recorded by some experimenters and contradicted by others. The controversial results all lie around wavelengths in the neighbourhood of 1 Å. The authors have used a very different technique for seeking modified lines in the region of soft X-rays. They use a vacuum spectrograph and tangential incidence to examine the spectra of the soft X-rays of various elements. A very diffuse line on the side of long wave-lengths is found whenever the K_α line of carbon appears on the plates. Its wave-length is 51 Å., which corresponds to 242 electron-volts, being 35 volts less than the K_α line of carbon. It is concluded that the diffuse line is due to the expulsion of an electron from the L-level by a quantum of K_α radiation, a certain amount of its energy being lost in the process. Certain discontinuities of absorption are also discussed. H. L. B.

5046. Emission Series in Ultra-Soft X-Rays. J. A. Prins and A. J. Takens. *Zeits. f. Physik*, 77. 11–12. *pp.* 795–800, *Sept.* 3, 1932.—Earlier plane-screen measurements are extended; they now cover the K-, L-, M- and N-series. The method of measurement enables a comparison to be made of the relative intensities of these series. Data of other observers are considered and theoretically investigated. A. D.

5047. K-Absorption Limits in Phosphors. E. Rupp and F. Schmidt. *Ann. d. Physik*, 14. 4. *pp.* 413–414, *Aug.* 1, 1932.—It is shown that when the curves previously obtained by Rupp for the light intensity against voltage for CaS(Pb) and ZnS(Ca) are reduced to equal X-ray energy, they agree with those of Wesch [see Abstract 2406 (1932)]. It is considered however that neither set of measurements is accurate. J. E.

5048. Survey of the K-Satellites. O. R. Ford. *Phys. Rev.* 41. *pp.* 577–587, *Sept.* 1, 1932.—A survey of the α-satellites from Ge (32) to Mg (12) reveals new lines in the $K\alpha'$ series, from the element Ca (20) to Va (23). The $K\alpha_{3,4}$ doublet is resolved over five additional elements, from Ca (20) to Mn (25). The $K\alpha_3$ line is shown to have two components, $K\alpha_3$ and $K\alpha_3'$, over the range of elements Al (13) to Cl (17). Microphotometer records, tracings of which are shown, reveal a significant reversal in the relative intensity of $K\alpha_3$ and $K\alpha_4$. This reversal is an atomic phenomenon and is not dependent upon chemical combination. The survey of the β-satellites from Cu (29) to Cl (17) adds two new lines of the $K\beta''$ series in the elements Cr (24) and Cl (17), four new lines in the $K\beta\eta$ series from Va (23) to K (19), and reveals two new series, named $K\beta^{IV}$ and $K\beta^{V}$. The $K\beta^{IV}$ series was found in three elements, *viz.*, Sc (21), Ca (20) and K (19), while the $K\beta^{V}$ series, which starts at the element Ca (20), extends downward to Cl (17) and probably further. While none of the points in the new series was obtained from the free elements, the behaviour of their semi-Moseley diagrams resembles those of the other β-satellites. To relate all the β-satellites to $K\alpha_2$ rather than $K\beta_1$, as has been customary, is shown to be of great convenience in the experimental study and classification of the β-satellites; the physical significance of this mode of representation, however, is problematic. AUTHOR.

5049. Improved Laue Camera. H. Kersten and W. Lange. *Rev. Sci. Instruments*, 3. *pp.* 493–496, *Sept.*, 1932.—When Laue photographs are made with a relatively small crystal-to-film distance, the central portions of the plate tend to be over-exposed as compared with the outer portions, owing to the different distances through which the diffracted beams travel. The authors describe a camera which is designed to overcome this difficulty. Compensation for unequal exposure is obtained by inserting a cam-shaped disc between the crystal and the plate. This disc is rotated and the central portions of the plate are thus covered for a longer time than are the outer portions. Any kind of compensation may be obtained by altering the shape of the disc. J. T.

5050. Double-Crystal X-Ray Vacuum Spectrometer. L. G. Parratt. *Phys. Rev.* 41. *pp.* 553–560, *Sept.* 1, 1932.—A double-crystal ionisation spectrometer is described in which the two crystals, the slits and the ionisation chamber are contained within a tank which is used as the fore-vacuum for the mercury condensation pump employed. Alignment of the focal spot with the slits is effected by an adjustable target. A method is explained for obtaining thermal contact with uranium for use as the target. The crystals and ionisation chamber are adjusted by means of long tapered bearings extending through the base of the instrument. J. T.

5051. "Starring" in X-Ray Diagrams. W. Berg. *Zeits. f. Krist.* 83. *pp.* 318–322, *Aug.*, 1932.—Experimental details referring to the star-like figures observed under certain conditions in Laue diagrams. F. I. G. R.

5052. Effect of a Secondary Structure upon the Interference of X-Rays. H. M. Evjen. *Phys. Rev.* 41. *pp.* 265–273, *Aug.* 1, 1932.—Laue's dynamic theory of X-ray interference is shown to be applicable, with only a few minor changes, to crystals having a very general type of secondary structure. It is thus applied for the purpose of obtaining a quantitative estimate of the effect of such a structure upon the nature of the X-ray interference maxima. The estimate is relative in so far as it compares the intensities of respectively the "secondarily" and the "primarily" reflected interference beams and applies only in the region where the latter have been, or can be, observed. In this region the "two-dimensional lattice" type of secondary structure is found to give rise to a fine structure which, with the present insufficient resolving power, would be manifested experimentally as a weak, diffuse background. The secondary structure of this type produces no broadening of the primary lines. The existence of this type of structure, therefore, is not inconsistent with the sharpness of the interference maxima obtained from such crystals as calcite, and a possible objection to the existence of the secondary structure in such crystals is removed. The extinction effect is briefly considered, but absorption is not taken into account, except with a few qualitative remarks. AUTHOR.

5053. X-Ray Diffraction from Calcite for Wave-Lengths 1·5 to 5 Å. L. G. Parratt. *Phys. Rev.* 41. *pp.* 561–576, *Sept.* 1, 1932.—Theoretical expressions for the coefficient of reflection, percentage reflection and width of line to be expected from the second crystal of a double spectrometer in the (1, −1) position, are evaluated for calcite for six lines in the region 1·54 to 5 Å. The calculation is based on Darwin's theory of reflection from a perfect crystal as modified by Prins. With a specially designed double-crystal spectrometer, experimental values of these three quantities are obtained for ten wave-lengths from copper K_a-radiation and for nine lines selected from the uranium M-series. Agreement between observed and calculated widths is very good throughout the whole region and gives no evidence of mosaic structure in the crystals. Good agreement is obtained in the case of the coefficient of reflection for wave-lengths shorter than 4 Å. The calculated values for percentage reflection are always 16 % above the observed values. J. T.

5054. Compton Effect. J. Thibaud. *Congrès International d'Électricité, Paris, Sect.* 1. *Rapport No.* 33. [13 *pp.*], 1932.—A general review of the subject showing how the difficulties which arise in the interpretation of the experimental results on the diffusion of X-rays by means of the electromagnetic theory have been finally overcome by the discovery of a new phenomenon, which is completely explicable by quantum mechanics; the essential physical consequences being an increase in the wave-length of the diffused X-rays depending uniquely on the angle of diffusion, and a setting in motion at the same time of the diffusing electrons as rapid projectiles. H. N. A.

5055. Passage of Photons through Atoms. V. Posejpal. *J. de Physique et le Radium*, 3. *pp.* 390–407, *Sept.*, 1932.—Recent work upon the neutron encourages the author to consider the properties of an ether composed of atoms of atomic number zero, formed by a close combination of an electron and a proton. Such an ether would be polarised by nuclear fields and would form ether enclosures. Fresnel's coefficient is calculated and found to be $1 - \delta/(d + \delta)n^2$, in which n = refractive index of the medium, d = the mean path of a photon in the polarised ether between two atoms, δ = its path in the free ether between them. It is deduced that the velocity of the photons in the ether enclosure is, for visible light, smaller than the velocity in the free ether and increases with the frequency: further, d decreases with increase of wave-length. The closest distance of approach of a photon to a nucleus is calculated and the results shown to be in conformity with experimental evidence. An attempt is made to calculate the scattering of radiation of high energy assuming that the photons which penetrate to an atomic energy level are scattered without change of wave-length. The scattering coefficient so deduced is $\mu = N^3\pi a^2$(N^3 = number of atoms per unit volume, a = radius of the level). For X-rays and γ-rays the formula takes the form $\mu_e = \pi a^2/Z + \pi r^2$ where Z = atomic number, r = radius of electron, μ_e = coefficient of total scattering for a single electron. This formula shows some numerical agreement with experimental results. J. E. R. C.

5056. Scattering of X-Rays from Solids. A. W. Coven. *Phys. Rev.* 41. *pp.* 422–431, *Aug.* 15, 1932.—The total scattering of the Kα radiation of molybdenum from powdered crystals of KCl, NaF and MgO has been observed with an ionisation chamber whose window subtended several degrees of angle at the scatterers. The scattering from NaF and MgO was found to be approximately the same as that from neon. The scattering from KCl was found to be approximately the same as that from argon. The intensities of the diffracted portion of the scattered rays from the crystals have been calculated and found to be distributed along the F^2/Z curves, thus agreeing with Jauncey's relation between gas and crystal scattering, $S_g = S_c + F^2/Z$. The sums of the diffracted intensities plus diffuse intensities have been found to follow the gas scattering curves, in agreement with Compton's formula for the scattering from a monatomic gas, $S_g = (f^2/Z) + (1 - f^2/Z^2)/R^3$. The method of measurement may be used to determine values of the structure factor for the atom at rest. AUTHOR.

5057. X-Ray Scattering in Liquids (Hg, Ga, CCl_4). H. Menke. *Phys. Zeits.* 33. *pp.* 593–604, *Aug.* 15, 1932.—In the experiments described, a primary beam of monochromatic X-radiation is incident on the liquid specimen and the variation of the intensity of the scattered X-rays for different scattering angles, is determined. The scattering from an isolated atom is derived theoretically assuming the Thomas–Fermi electron distribution in the atom. For a monatomic liquid the scattering law is then deduced in terms of a probability function $W(r)$ which represents the probability of any two particular atoms occupying respectively volume elements dV_1 and dV_2 separated by a distance r. Applying the theory to the experimental results the form of $W(r)$ is obtained. For both mercury and gallium $W(r)$ is zero up to a certain r-value and then, with increase of r, executes damped periodic oscillations about a final asymptotic value. If the atoms were free mass points $W(r)$ would be a constant; the actual form of $W(r)$ corresponds crudely to a close packing of impenetrable atom spheres. For CCl_4 the theory is much more complicated and a simple interpretation of the experimental results in terms of a function W(*r*) is not possible. The conclusion can, however, be drawn that, in the liquid, the CCl_4 molecules are not free and freely rotating molecules arranged in the same way as the Hg atoms. W. S. S.

5058. X-Ray Scattering by Molecules Containing Two Carbon Atoms. F. Ehrhardt. *Phys. Zeits.* 33. *pp.* 605–614, *Aug.* 15, 1932.—The X-ray scattering curve (scattered intensity as a function of the angle of scattering) was determined experimentally for the following substances in the gaseous state: 1:1-dichlorethane, 1:2-dichlorethylene (*cis* and *trans* isomers), 1:2-dichlorethane. Following Debye, the form of the scattering curve can be predicted theoretically if the distances apart of the atoms in the molecule are known. For the distances C–C and C–Cl, known fixed values are assigned, and in each case it remains only to find the distance apart of the Cl atoms which shall give a computed scattering curve in agreement with experiment (the scattering by H atoms is negligible and their positions in the molecule do not arise). For 1:1-dichlorethane the separation of the Cl atoms is found to be 3·15 Å. (against 3·0 Å. for CCl_4 thus confirming Bewilogua's result that when two Cl atoms are attached to the same C, the valency directions are forced farther apart. For the dichlorethylene isomers the distance apart of the Cl atoms was found to be 3·7 Å. for the *cis* and 4·7 Å. for the *trans* molecule. In 1:2-dichlorethane the two parts of the molecule are joined by a single carbon bond and the existence of rotational degeneracy about this linkage is in question. It appears that there is a preferred stable arrangement—the *trans* arrangement—about which oscillations occur. The distance apart of the Cl atoms in the preferred arrangement is found to equal 4·4 Å. W. S. S.

5059. Scattering of X-Rays and Kathode Rays by Single Molecules. L. Bewilogua. *Phys. Zeits.* 33. *pp.* 688–692, *Sept.* 15, 1932.—General formulæ are stated for the intensity of X-rays or kathode rays scattered by a single molecule of *n* atoms as a function of $(\sin\theta)/\lambda$, where θ is the angle of scattering and λ is the wave-length. The formulæ embody coherent scattering, which is treated by summing the interference pattern produced by the *i*th and *j*th atoms for all values of *i* and *j*; and incoherent scattering which does not depend upon molecular structure. The influence of thermal vibration is neglected. Scattering by benzene, which is considered as a plane hexagon with C–H units, is calculated, the coherent scattering summations being evaluated in terms of the adjacent H–H, C–H and C–C distances and the usual structure factors. In the case of X-ray scattering, a simplification is made by considering that the H electrons form part of the outer shell of the adjacent C atom, so that, if the structure factor for C^- be used, only a simple hexagon of C^- need be considered. In kathode-ray scattering the nuclei are also effective and this simplification cannot be introduced. The contribution of the incoherent scattering by C and H atoms is deduced from values given in an earlier paper [see Abstract 1262 (1932)], and the coherent, incoherent and total scattering curves are given. The effect of the incoherent scattering upon the prominence of the minima due to the coherent scattering is shown and in the case of X-rays, the predominance of the Compton scattering for large values of $(\sin\theta)/\lambda$ is pointed out. J. E. R. C.

RADIOACTIVITY.

5060. Uranothorites from Arendal District, Norway. Ellen Gleditsch and B. Qviller. *Phil. Mag.*, 14. *pp.* 233–243, *Aug.*, 1932.—Four uranothorites were completely analysed and their radium content determined, giving for the value of the ratio $Pb/(U + 0{\cdot}36Th)$: (1) 0·064, (2) 0·055, (3) 0·041 and (4) 0·030, and for the ratio ($\times 10^7$) Ra/U, 3·20, 3·01, 2·76 and 1·98, the equilibrium value being 3·40. The atomic weight of the lead in (3) is 207·016, which, assuming absence of ordinary lead, indicates that the lead isotopes consist of 51 % ThD and 49 % RaG, whence ages of 429·9 and $243{\cdot}6 \times 10^6$ years are deduced, the accepted age for such rocks being approximately 10^9 years. These facts all point to a leaching out of radium and lead, more particularly of thorium-lead, ThD, possibly due to the fact that the uranium-lead was protected through formation of a very insoluble uranate, the thorium-lead existing as the less insoluble oxide or silicate. [See Abstract 2038 (1926).] C. A. S.

5061. Range and Total Ionisation of α-Rays in Gases. M. Mäder. *Zeits. f. Physik*, 77. 9–10. *pp.* 601–615, *Aug.* 24, 1932.—The ionisation produced by the α-rays from polonium in the gases air, CO_2, O_2 and N_2 was investigated by the method of pressure variation in the ionisation chamber. By using a compensation arrangement a measurement of the ionic current with an accuracy of 0·15 % was obtained. Besides these direct measurements the quantity of ions appertaining to various long α-ray paths was found, and values for the capacity of retardation and the range in the gases mentioned. The decay constant for polonium was also determined. J. J. S.

5062. New Measurements of the Ranges of α-Particles from Polonium, Uranium I and Uranium II with the Wilson Chamber. F. N. D. Kurie. *Phys. Rev.* 41. *pp.* 701–706, *Sept.* 15, 1932.—The Wilson cloud chamber method of range measurement (to be described by the author in another paper) has been applied to the α-particle ranges of polonium, uranium I and uranium II. The polonium measurements were undertaken as a check on the method, but are in sufficiently good accord with previous results to stand alone. The range of polonium α-particles at 0° C. and 760 mm. is $3{\cdot}690 \pm 0{\cdot}005$ cm. The range of uranium I α-particles is $2{\cdot}58 \pm 0{\cdot}015$ cm. and that of uranium II α-particles is $3{\cdot}11 \pm 0{\cdot}01$. The polonium range is derived from 335 tracks while the uranium ranges are due to a total of 594 tracks. A method of separating the number-distance curves of the two uraniums is described which eliminated the uncertainty of finding the shorter range. The uranium data are in excellent agreement with the results of Laurence [see Abstract 2420 (1928)]. This agreement is thought to be entirely fortuitous in so far as uranium I is concerned. The precision of Laurence's work is criticised.

AUTHOR.

5063. Scattering of α-Particles at Small Angles by Helium. P. Wright. *Roy. Soc., Proc.* 137. *pp.* 677–688, *Sept.* 1, 1932.—The annular ring method as originally adapted by Rutherford and Chadwick [see Abstract 3148 (1927)] for the observation of the scattering of α-particles

by helium is used but the scattered particles are recorded by a Geiger proportional counter in conjunction with a valve amplifier in place of the usual scintillation counter. The observed scatterings at angles 10°, 15° and 27° are in good general agreement with Taylor's theory [see Abstract 1653 (1932)] based on wave-mechanical scattering by the region of the helium nucleus where the forces differ from the inverse-square forces.
F. C. C.

5064. Constitution and Spin of Atomic Nuclei. F. Perrin. *Comptes Rendus*, 195. *pp*. 236–237, *July* 18, 1932.—The author discusses the spins of the components of a nucleus. He assumes that a nucleus will arrange itself so that it contains neutrons, α-particles (helions) and demi-helions, and in this way the absence of spin of nuclear electrons may be explained. He suggests that a neutron should have a spin of 1/2 and should obey the Fermi statistics. They would then resemble the outer electron shells, the spin and orbital momentum being usually balanced out in pairs. An odd number of neutrons will give a resultant spin of 1/2 and an integral or zero orbital momentum. The demihelions should have a spin of 1 and should obey the Bose statistics, contributing no orbital momentum. Two demihelions in a nucleus would add their spins and form an α-particle. The abnormal Landé factors are attributed to the fact that only neutrons provide an orbital angular momentum and they cannot contribute anything to the magnetic moment. The above hypotheses agree with such nuclear spins as are known with certainty. J. E. R. C.

5065. Constitution of Atomic Nuclei. D. Iwanenko. *Comptes Rendus*, 195. *pp*. 439–441, *Aug*. 17, 1932.—It is suggested that the nuclei of atoms are made up of α-particles, protons (π) and neutrons (ω), the last possessing spin 1/2 and obeying Fermi–Dirac statistics. Thus N^{14} would be $3\alpha + 1\pi + 1\omega$ with spin 1. [See Abstract 3315 (1932).] C. A. S.

5066. Structure of Atomic Nuclei. Part II. W. Heisenberg. *Zeits. f. Physik*, 78. 3–4. *pp*. 156–164, *Sept*. 21, 1932.—A continuation of an earlier paper [see Abstract 4383 (1932)]. The stability of nuclei containing either an odd or an even number of neutrons is considered and a qualitative agreement obtained between predicted and observed stabilities. The nuclear scattering of γ-radiation is considered on the basis of a nucleus formed from protons and neutrons and agreement is again obtained. The possibility of the incident γ-radiation exciting the nuclear neutrons to emit other γ-radiation is pointed out. The paper concludes with a discussion of the properties of the neutron. J. E. R. C.

5067. Collision of α-Particles with Atomic Nuclei. H. S. W. Massey. *Roy. Soc., Proc*. 137. *pp*. 447–463, *Aug*. 2, 1932.—Theoretical investigations of the impact of an α-particle upon a nucleus are hampered by the strong perturbation of the α-particle wave by the nuclear potential barrier. The author develops a theory which removes this difficulty. Elastic scattering by light nuclei and the probability of an α-particle exchange upon impact are investigated and it is shown that the latter is of considerable importance when the α-particle energy is in the neighbourhood of a resonance level of the nucleus. It then has the effect of broadening the level. J. E. R. C.

5068. Reversal of Radioactive Processes. H. Zanstra. *Zeits. f. Physik*, 77. 5–6. *pp*. 391–394, *Aug*. 2, 1932.—The liberation of a proton or a neutron by the entry of an α-particle into the nucleus, and the reverse process, is regarded as a kind of reversible chemical reaction. By applying the law of mass action, it is shown that the ratio of the effective cross-sections (defined in the paper) is related in a simple manner to the mass and velocity of the particles. This suggests the possibility of an experimental test of the validity of the application of thermodynamic and statistical principles to nuclear processes. W. E. P.

5069. Mass Defect and Binding Energy of a Neutron. W. Braunbek. *Zeits. f. Physik,* 77. 7–8. *pp.* 534–540, *Aug.* 6, 1932.—Assuming that a neutron consists of a proton embedded in an electron, the author calculates the mass defect and binding energy of the combination. A value of $1{\cdot}0 - 1{\cdot}5 \times 10^6$ electron volts is obtained for the binding energy and agrees with the value deduced by Chadwick from experiments upon Be and B. J. E. R. C.

5070. Impacts of Fast Electrons and Magnetic Neutrons. J. F. Carlson and J. R. Oppenheimer. *Phys. Rev.* 41. *pp.* 763–792, *Sept.* 15, 1932.—The passage through matter of electrons with energy large compared with their proper energy is considered, and the collisions of a magnetic neutron are discussed. Möller's method for the relativistic treatment of collisions is extended and applied to (*a*) collisions of two free electrons, (*b*) collisions of a free electron in which little energy is transferred to the secondary, (*c*) collisions of a magnetic neutron with a free electron. The range and ionising power of a fast electron are calculated and the whole of the foregoing results are found to be in close agreement with the recent theoretical treatments of Heisenberg and Bethe. The behaviour of a certain type of magnetic neutron in collisions with electrons, protons and nuclei is examined, and it is considered that the results are not in agreement with the experimentally observed properties of the penetrating radiation obtained by bombardment of beryllium with α-particles. The possible limitations of Möller's methods are emphasised in view of the neglect of radiation losses, of reaction of the particle to its own field and of higher order terms in the interaction of two particles. A useful summary is given of the more important formulæ which are derived. F. C. C.

5071. Excitation of Neutrons from Beryllium. F. Rasetti. *Zeits. f. Physik,* 78. 3–4. *pp.* 165–168, *Sept.* 21, 1932.—The author discusses the emission of neutrons and γ-radiation from Be under α-particle bombardment with the object of deciding whether the two radiations are the result of a single process or of two. Experiments were made upon the radiations using an ionisation chamber containing CH_4 at atmospheric pressure. The chamber had a natural activity of 8 ions per c.c. per sec. whilst the radiations increased the ionisation by 25 %. The ionisation due to the radiation was measured for α-particle ranges of 8 mm. up to the full range of a polonium α-particle. The results are exhibited graphically and the curve shows a discontinuity for α-particle ranges between 12 mm. and 17 mm. From the similarity of his curve to that obtained for the γ-rays from Be by Bothe and Becker [see Abstract 1583 (1931)], the author deduces that the γ-rays and neutrons are emitted in the same process. J. E. R. C.

5072. Wave-Mechanical Classical Structure for a Neutron. H. K. Kudar. *Zeits. f. Physik,* 78. 3–4. *pp.* 279–282, *Sept.* 21, 1932.—The possibility of a model of a neutron constructed upon wave-mechanical

classical lines is shown. Qualitative use of wave mechanics leads to an understanding of the paradox that β-rays of variable energy can be emitted from elements with sharply defined decay constants. The model does not lend itself to a quantitative treatment and alternative models are discussed.
J. E. R. C.

5073. Fundamental Particles. R. M. Langer. *Science,* 76. *pp.* 294–295, *Sept.* 30, 1932.—A discussion of the possible existence of fundamental particles other than the proton and the electron. The following are considered: (1) negative energy electron; (2) a combination of (1) with an ordinary electron to form a photon; (3) the addition of Dirac positive and negative magnetic poles to form neutrons; (4) combination of a neutron and a positive electron to form a proton. J. E. R. C.

5074. Passage of Particles Charged with Electricity through Matter. L. W. Wertenstein. *Congrès International d'Électricité, Paris, Sect.* 1. *Rapport No.* 17. [20 *pp.*], 1932.—A general review of the behaviour of electrons, protons, α-particles, recoil atoms, canal rays. Attention is called to the differences in the theory of range, using the classical theory and the quantum theory. It is pointed out that in spite of the great improvements made by means of the quantum theory, the results are not perfect, and new theoretical and experimental investigations are needed.
H. N. A.

5075. Scattering of Fast β-Particles by Electrons. F. C. Champion. *Roy. Soc., Proc.* 137. *pp.* 688–695, *Sept.* 1, 1932.—The expansion method is used to photograph over 0·5 km. of track of fast β-particles in nitrogen. The velocities of the particles lie between 0·82 and 0·92 of that of light and 250 collisions with atomic electrons are obtained in which the angle of scattering is greater than 10°. The results are compared with various theoretical formulæ and it is found that the absolute numbers scattered and the distribution with angle are in good agreement with a formula of Møller [see Abstract 3719 (1931)] based on quantum mechanics. AUTHOR.

5076. Effect of β- and γ-Rays on Alkali-Manganese Glasses Containing Cl′, F′ and SO$_4''$. J. Hoffman. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 1–2. *pp.* 55–62, 1932.—These results on glasses of very different compositions confirm the author's previous results that blue and violet colouring is not due, as far as silicate glasses are concerned, to alkali atoms. Red coloration under radiation is attributed to $Mn^{(+III)}$ and $Mn^{(+IV)}$ ions, violet to the simultaneous presence of Mn^{+III} and Mn^{+II} ions. Glasses with Mn^{+II} ions associated with Fe are coloured grey, while $Mn^{(+II)}$ ions not associated with Fe give no coloration. J. E.

5077. Radioluminescence and Radiophotoluminescence. Part III. K. Przibram. *Akad. Wiss. Wien, Ber.* 141. 2*a*. 3–4. *pp.* 283–289, 1932.—A continuation of previous work on the red radiophotofluorescence shown by certain fluorites [see Abstract 2062 (1924)]. They show a diffuse band in the red without any marked lines. The phenomenon is confined often to certain spots of the crystal which are different from those showing a blue fluorescence. Many fluorites acquire the power of fluorescing red under radium treatment only after heating. Synthetic preparations of CaF show that the same effect can be obtained without the presence of rare earths. It is therefore due to heavy metal impurities unless the rare earths do not give here their characteristic lines. J. E.

HEAT.

5078. Conduction of Heat in Tubes with Non-Uniform Temperature Distribution. A. Konejung. *Zeits. f. angew. Math. u. Mechanik,* 12. *pp.* 229–233, *Aug.*, 1932.—Formal solution and particular examples are here worked out for the flow of heat through the walls of a boiler tube in which the isothermal surfaces are not cylinders coaxial with the tube, but are of a more general character determinable by measurement. J. P. A.

5079. Heaviside's Operational Method and Problems of Heat Conduction. S. Goldstein. *Zeits. f. angew. Math. u. Mechanik,* 12. *pp.* 234–243, *Aug.*, 1932. *In English.*—Heaviside's method is summarised, and its advantages discussed. As examples, the temperature at any point at any time is found in an infinite solid slab of thickness $2l$, in an infinitely long circular cylinder of radius R, and in a circular cylinder of length $2l$ and radius R, initial conditions being given. J. P. A.

5080. Heat Transfer between Gas and Walls. E. Brun and P. Vernotte. *Comptes Rendus,* 195. *pp.* 302–304, *July* 25, 1932.—Describes experiments on the coefficient of thermal exchange between a current of gas and the wall past which it is flowing. The range of velocities covered is 40 to 85 m. per sec. To a very close approximation, the relation betwen v, the velocity, and h, the watts transferred per sq. cm. per ° C. is $h = 55 \times 10^{-7} v$. J. W. T. W.

5081. Energy Exchange between Inert Gas Atoms and a Solid Surface. J. M. Jackson and N. F. Mott. *Roy. Soc., Proc.* 137. *pp.* 703–717, *Sept.* 1, 1932.—If gas atoms having energy corresponding to a temperature T_2 are incident on a solid surface at a temperature T_1, then the reflected atoms will have a mean energy corresponding to some new temperature T_2' which is a function of T_1 and T_2. For simplicity Knudsen's thermal accommodation coefficient is defined as

$$a = \lim_{T_1 \to T_2 \to T} \frac{T_2' - T_2}{T_1 - T_2}$$

The accommodation coefficient depends on the nature of the gas atom, the nature of the solid surface and the temperature T. The authors give a theoretical explanation of the results of Roberts, who measured the accommodation coefficient for helium on tungsten at various temperatures, taking particular precautions to obtain a clean surface. In the discussion an exponential field between the gas atom and a surface atom of the solid is used. Good agreement with the experimental results of Roberts is obtained. [See Abstract 2025 (1932).] J. J. S.

5082. Absorptive Power of Blacks and Whites of Radiometers. E. Hasché. *Ann. d. Physik,* 14. 3. *pp.* 342–352, *July* 20, 1932.—Measurements of the absorptive power of the Ångström pyrgeometer, in the spectral range 0·6 to 50 μ, are described. The discrepancy is discussed between the values of the pyrgeometer constant determined (*a*) by a control measurement with black-body radiation, (*b*) by calculation from the absorptive power. [See Abstract 1950 (1931).] W. S. S.

5083. Most Probable Value of the Stefan–Boltzmann Radiation Constant. F. E. Hoare. *Phil. Mag.* 14. *pp.* 445–449, *Sept.*, 1932.—The most probable value of σ, the Stefan–Boltzmann radiation constant, derived as the weighted mean of 23 determinations, ranging in numerical value from $5\cdot3$–$6\cdot51(\times 10^{-5})$, is considered to be $(5\cdot742 \pm 0\cdot019) \times 10^{-5}$ erg./cm.^{2}/sec./degree.^{4} The corresponding value of Planck's constant, h, is $(6\cdot536 \pm 0\cdot011) \times 10^{-27}$ erg. sec., which agrees well with five values tabulated by Birge, and derived from the consideration of different phenomena. J. S. G. T.

5084. Precision Aperiodic Thermostat. O. H. A. and F. O. Schmitt. *Rev. Sci. Instruments*, 3. *pp.* 467–473, *Sept.*, 1932.—The chief feature of the instrument is that it avoids local variations in temperature which may exist in baths controlled by the usual type of thermostat. The water is brought from a tank where its temperature is pre-controlled by another thermostat, and then is finally controlled in the bath. J. H. A.

5085. Conditions for Producing Temperatures below 1° Absolute by Demagnetisation of Gadolinium Sulphate Octahydrate. W. F. Giauque and C. W. Clark. *Am. Chem. Soc., J.* 54. *pp.* 3135–3142, *Aug.*, 1932.—A progress report on a method devised for producing temperatures below those of liquid helium, previously described by the authors [see Abstract 3157 (1927)]. The method in outline is: (*a*) magnetisation of a suitable paramagnetic body; (*b*) absorbing the resulting heat by means of thermal conduction to liquid helium; (*c*) thermal isolation of the working substance from the helium bath; (*d*) reversible adiabatic demagnetisation with the consequent lowering of temperature. The object of the authors in the present treatise is to describe how such temperatures can be made available for experimental work, and also to supply information which would determine the magnetic field requirements in order to give data for the design of the magnet required. Gadolinium sulphate octahydrate is a suitable working substance. Details are given regarding purity of samples, heat capacity measurements and the entropy of the gadolinium sulphate octahydrate at low temperatures. The heat capacity was measured from 14° to 290° K. Extrapolation of the heat capacity results combined with the entropy of magnetisation is used to determine the conditions for production of temperatures below 1° K. by reversible adiabatic demagnetisation of the gadolinium sulphate octahydrate. Tables are given of the field-temperature isentropics. The data given would indicate that the demagnetisation of the gadolinium sulphate octahydrate at the temperatures of liquid helium not only provides enough cooling to produce temperatures considerably below 1° Abs., but that other substances may be cooled by gadolinium sulphate in order that their properties may be investigated under low-temperature conditions.
S. G. B.

5086. Thermal Dilatation of Crystals and Laws of Haüy. A. Cavinato. *Accad. Lincei, Atti*, 16. *pp.* 163–165, *Aug.*, 1932.—A demonstration is given that the laws of Haüy hold good when a crystal is expanded by heating. J. J. S.

5087. Triphenyl Phosphate as a Solvent in Cryoscopy. Part I. F. Garelli and G. Racciu. *Accad. Lincei, Atti*, 15. *pp.* 976–980, *June* 19, *and* 16. *pp.* 54–56, *July*, 1932.—With diphenyl, naphthalene, phthalic anhydride and triphenylmethane in concentrations of about 1 %, the molecular freezing-point depressions of triphenyl phosphate are fairly concordant, and lie between 130 and 140; toluene and urethane show somewhat abnormal behaviour. As with other solvents, the molecular depression at first usually falls rapidly as the concentration of the solute is increased, and afterwards tends to remain constant at about 119 for 1·5 to 2 % solutions. The heat of fusion of triphenyl phosphate is found to be about 17·56 cal., which gives 117·6 for the molecular depression. Abnormal results are given by benzoic acid, probably owing to the formation of complex molecules, but salicylic acid gives more normal values. Triphenylphosphine is also abnormal, and probably forms solid solutions with the solvent. Sulphur exists as S_{10} in triphenyl phosphate at about 50° C., iodine as I_2, trimethylenetrinitrotetramine as $(CH_2N \cdot NO_2)_3$, and indigo as the simple molecule, $C_{16}H_{10}O_2N_2$. T. H. P.

5088. Cryoscopic Purity Test of Liquids and the Purification of Cyclohexanol. J. Lange. *Zeits. f. phys. Chem.* 161. *Abt.A.* 1–2. *pp.* 77–82, *Aug.*, 1932.—A description is given of a cryoscopic test, based on stepwise freezing, and not on the absolute maximum temperature, as a purity criterion for liquids. Details are also included for preparing pure cyclohexanol. H. H. Ho.

5089. Thermal and Crystallographic Analysis of the Lithium-Tin System. A. Baroni. *Accad. Lincei, Atti,* 16. *pp.* 153–158, *Aug.*, 1932.—A thermal study was made of the system Sn-Li, and the diagram of state is given. The existence of three compounds is shown: Li_4Sn which melts at 684° C., Li_3Sn_2 melting at 483° and $LiSn_4$. There are three eutectic points at 458°, 320° and 214°, corresponding respectively to 35, 58 and 94 atomic % of tin. Examination by X-rays showed compounds Li_4Sn and Li_3Sn_2. The photographs obtained by the method of powders were not clear and did not permit the certain calculation of the structure of these compounds. It was not found possible to identify the compound $LiSn_4$ with X-rays. J. J. S.

5090. Constant-Boiling Mixtures Applied to Analysis of Impurities in Liquids. W. Świetoslawski. *Acad. Polonaise Sci. et Lettres, Bull. No.* 1–7*A. pp.* 74–79, *Jan.–July,* 1932.—If a liquid L contains small traces of a dissolved impurity A, the quantity of the latter may be determined by means of boiling-point measurements, provided that a third substance B, also soluble in L but not in A, can be found, such that a constant boiling-mixture of A, B and L exists, and also constant-boiling mixtures of the various pairs. Now if a quantity of the component B is added to the constant-boiling mixture of A and L, the boiling point of the A,B,L mixture is lowered considerably below that of the A,L mixture. In practice, the constant-boiling mixture of B and L is prepared, and A is added a little at a time, the boiling point being observed at each addition. The constant-boiling mixture of B with the liquid under examination is next prepared, and its boiling point immediately shows the quantity of A present. The method attains an accuracy of about 0·003 %. An alternative method of experimenting is also described. [See also following Abstract.] J. H. A.

5091. Determination of Traces of Water and of Azeotropic Dehydrator in Ethyl Alcohol. W. Świetoslawski and (Miss) J. Szmigielska. *Acad. Polonaise Sci. et Lettres, Bull. No.* 1–7*A. pp.* 80–87, *Jan.–July,* 1932.—Applies the principles previously developed [see preceding Abstract], to determine the quantity of water, and of the petrol-benzene mixture used to carry off the water, in ethyl alcohol. When the quantity of water is about 0·09 %, it can be determined to about 0·004 %. The method is used up to concentrations of 1·3 %. J. H. A.

5092. Equation of High-Temperature Heat Content Data. C. G. Maier and K. K. Kelley. *Am. Chem. Soc., J.* 54. *pp.* 3243–3246, *Aug.*, 1932.—The equation $Q_{273\cdot1}^{T} = [aT + bT^2/2 + cT^{-1}]_{273\cdot1}^{T}$ for the representation of heat content data at high temperature T° (Abs.) is considered to be superior to the power series customarily employed. Its superiority is illustrated by application to data relating to zinc oxide (up to 1300° C.) and calcium silicate (up to 1400° C.). J. S. G. T.

5093. Correction for Incomplete Thermal Isolation in Measurement of Small Heat Capacities. W. H. Keesom and J. A. Kok. *K. Akad. Amsterdam Proc.*, 35. 3. *pp.* 294–300, 1932. *Comm. No.* 219*c* *from the K. Onnes Lab., Leiden.*—An accurate method is worked out for correcting for the heat exchange with the surroundings in measurements of very small heat capacities after Nernst and Eucken's method if thermal isolation is incomplete. AUTHORS.

5094. Heat Capacity of Selenium from 100° to 300° Abs. T. de Vries and L. F. Dobry. *Am. Chem. Soc., J.* 54. *pp.* 3258–3261, *Aug.*, 1932.—The heat capacity of metallic Se was measured by means of a Nernst calorimeter between the temperatures 98·3° and 278·3° Abs. Over this temperature-range the values obtained increase from about 6 to about 7 cal./mol./° C. L. G. C.

5095. Specific Heat of Radioactive Materials. (Miss) A. Dorabialska, T. Niwinski and (Miss) E. Turska. *Acad. Polonaise Sci. et Lettres, Bull. No.* 1–7*A. pp.* 88–94, *Jan.–July,* 1932.—Seven minerals (three uranium compounds and four thorium compounds) have been studied. The specimens were intentionally neither dried nor purified, and the specific heat was measured between 18° and 21° C. by an electrical method. Correction is made for the heat generated by the mineral during the determination. J. H. A.

5096. Specific Heat and Heat of Dissociation of Simple Hydrocarbons from Spectroscopic Data. R. Ruedy. *Canad. J. of Research*, 7. *pp.* 328–336, *Sept.*, 1932.—The specific heat at constant volume of methane, ethylene and acetylene has been computed from the vibrational frequencies involved in Raman effect and infra-red bands, and is found to agree with experiments of recent date. From the overtones of the infra-red methane band of 3022 cm.$^{-1}$ a heat of dissociation into probably CH_3 and H of 101 cal. per mole may be deduced. The number of collisions in which the energy could be transferred from molecule to molecule is too small, however, even at 1000° C., to account for the splitting up of methane into CH_3 and H in quartz tubes where in the initial stage catalytic effects are small. It is likely that the slower and the symmetrical vibrations lead to a lower level of dissociation into CH_2 and H_2, and that the finite time during which the molecule remains in these vibrational states influences the results. The need for studying the velocity of ultrasound in gases in order to gain a better knowledge of thermal decomposition processes is pointed out. AUTHOR.

5097. Chlorine Equilibria and Absolute Entropy of Chlorine from Spectroscopic Data. A. R. Gordon and C. Barnes. *J. Phys. Chem.* 36. *pp.* 2292–2298, *Aug.*, 1932.—The entropy of chlorine from 300° to 1000° C. is computed from the spectroscopic constants of Elliott; in conjunction with the known entropies of hydrogen chloride, oxygen and steam, the equilibrium constant of the Deacon reaction is calculated for the range 600°–1000° C. The agreement between the calculated and observed values of the equilibrium constant is satisfactory. It is shown that to the first order, the entropy of reaction is not affected by disregarding the existence of isotopes in the calculation; the rule appears to be general. AUTHORS.

5098. Entropies of Simple Polyatomic Gases from Spectral Data. R. M. Badger and Sho-Chow Woo. *Am. Chem. Soc., J.* 54. *pp.* 3523–3529, *Sept.*, 1932.—The gases dealt with are CO_2, N_2O, HCN and C_2H_2. Each of these is known to have a molecule which is linear, in its normal state, and in each case the infra-red spectrum, as well as the Raman spectrum, has been studied. The entropies of the first three are calculated from the spectral data, the absolute values being 51·07 for CO_2, 56·94 for N_2O and 51·79 for HCN, all taken at 298·2° K. The calorimetric value for CO_2 is 50·0 or 50·5, according to the value taken for the heat of formation. The interpretation of the spectral data for acetylene is less simple, and no numerical result is given. J. H. A.

5099. Structural Constant Relating to Changes of State. R. Bigazzi. *Accad. Lincei, Atti,* 16. *pp.* 48–53, *July,* 1932.—If T is the absolute temperature of any change of state of a pure substance, P its molecular weight, and p its specific gravity at 15°/4° C., it is found empirically that $TP/p^2 = \text{const.} = K$ or $T = Kp^2/P$ is valid for all compounds with similar structural formulæ, provided that no polymerisation, dissociation, etc., occur during the change of state. Since the molecular volume $V = P/p$, it follows that $K = TV/p$. In order to unite all molecules of various structures by means of a simple approximate constant of change of state (K^1), use is made of a complexity factor (c), which depends on the structural complexity of the molecules, and is such that $TP/p^2c = K^1$, whence $T = K^1p^2c/P$. To determine c, the graphic formula of the compound is drawn, use being made of a constant graphic unit (say 1 cm.) of structural valency. The segment representing the greatest width of the graphic molecule is taken as c, which represents the characteristic vector defining the state of equilibrium to which all the atoms constituting the molecule tend. The factor c varies from 1 (for bromine) to 13 (dodecane). The above expressions have been verified in some hundreds of cases for the changes: liquid-gas, liquid-solid, solid-liquid and gas-liquid. T. H. P.

5100. Electrical Resistance and the Critical Point of Mercury. F. Birch. *Phys. Rev.* 41. *pp.* 641–648, *Sept.* 1, 1932.—Values are given for the relative resistance, the instantaneous pressure coefficient of resistance and the instantaneous temperature coefficient of resistance of liquid mercury in the region between 0° and 1200° C., and 1 and 4000 atmospheres. All of these quantities increase with rising temperature and decrease with rising pressure in this region. With the assumption that the resistance must be a continuous function of the temperature, for pressures higher than the critical pressure, the critical constants of mercury have been determined as 1460 ± 20° C. and 1640 ± 50 kg./cm.^{2}. AUTHOR.

5101. Twin-Bomb Method for Measuring High Pressures. E. W. Washburn. *Bureau of Standards, J. of Research,* 9. *pp.* 271–278, *Aug.,* 1932.—By filling one bomb with the system under investigation and a twin bomb with a reference substance, and then adjusting the pressures in the two bombs to exact equality at a given temperature with the aid of a pressure equaliser, the ratio of PV_0/T for the two systems can be accurately determined by weighing the two bombs, no pressure measurements being involved. If the volume of the second bomb is known, the value of PV_0/T for the system under investigation may be computed with the accuracy with which this magnitude is known for the reference substance. Moreover, if a gasfilled bomb of volume V at a known temperature T is brought into pressure equilibrium with any system at the pressure P and the mass of the contained gas is determined, the value of P may be calculated with the accuracy to which PV_0/T is known for the gas employed. By this means an ordinary balance and weights may be utilised as a laboratory tool for the accurate measurement of high pressures. This method will be useful especially where accurate dead-weight pressure gauges are not available. T. H. P.

5102. Torsion Balance Method for the Measurement of Very Small Vapour Pressures. K. Neumann and E. Völker. *Zeits. f. phys. Chem.* 161. *Abt.A.* 1–2. *pp.* 33–45, *Aug.,* 1932.—The substance is placed in a glass vessel having 2 small orifices so situated that when the vessel is suspended by a quartz fibre within an evacuated vessel the issuing vapour causes a torsional stress in the thread. Details are given of the theory of the method and of the construction of the apparatus, and measurements with benzophenone (11·6°–54·6° C.), mercury (16·4°–70·7° C.) and potassium (144·7°–199·3° C.) are described. The vapour pressure-temperature equations of the liquid and two solid forms of benzophenone are given; the calculated heat of the transition of the latter is 700 cal. The vapour pressure of mercury in mm. is given by $\log (pT^{0 \cdot 848}) = C - B/T$, where T is the temperature in degrees Abs., $B = 3328 \pm 15$, and $C = 10 \cdot 53 \pm 0 \cdot 04$; the chemical constant $i = 1 \cdot 91 \pm 0 \cdot 06$. For potassium the equation is $\log (pT^{1 \cdot 37}) = C - B/T$, where $B = 4768 \pm 15$ and $C = 11 \cdot 58 \pm 0 \cdot 04$, and the chemical constant is $1 \cdot 105 \pm 0 \cdot 05$. H. F. G.

5103. Vapour Pressure Measurements. H. Moser. *Ann. d. Physik,* 14. 7. *pp.* 790–808, *Sept.,* 1932. *From the Reichsanstalt.*—A static method for precise vapour pressure measurements above room-temperature is described which was devised specially for accurate temperature measurements in the neighbourhood of 100° C., but is suitable in principle for other vapour pressure measurements at high temperature. The apparatus consists essentially of a glass-membrane manometer which is heated somewhat above the temperature investigated and with the help of which it can be determined when the vapour pressure acting on the one surface of the membrane is equal to the pressure on the other surface exerted by a gas standing in connection with a mercury manometer. This enables the 100° point to be measured with an accuracy of ±0·001°. A comparison with the hitherto usual dynamic methods of measurements shows that these have two or three times greater variations and are not quite free from systematic errors of the same magnitude. The dependence on temperature of the vapour pressure (p) of water in the neighbourhood of 100° C. was newly determined and found to be expressed by the relation

$t = 100{,}000 + 0\cdot03687(p - 760) - 0\cdot000022(p - 760)^2$ between 680 and 780 mm. Hg with an accuracy of about 0·001°. J. J. S.

5104. Vapour Pressure of Recently Frozen Liquid Water. A. W. C. Menzies. *Nat. Acad. Sci., Proc.* 18. *pp.* 567–568, *Sept.*, 1932.—Briefly describes experiments which led to the conclusion that at 3·5° C. and 25° C. there is no difference greater than 0·05 mm. of mercury between the vapour pressure of recently frozen, re-melted water and that of water recently heated to 100° C. G. G. S.

5105. Phase Rule. P. van Rysselberghe. *J. Phys. Chem.* 36. *pp.* 1733–1737, *June*, 1932.—Attention is directed to the formulation of the phase rule by de Donder (*Leçons de Thermodynamique et de Chemie physique* (1920), *pp.* 125–139) involving a precise definition of the number of "independent constituents" of a heterogeneous system. The phase rule is formulated as $v = C - r + 2 - \phi$, v denoting the variance of the system, ϕ the number of phases, and $C - r$ the difference between the total number of constituents of the system and the number of distinct chemical reactions. Its application to systems of any degree of complexity is simple; it affords an unambiguous solution of the problem of determining the masses of all constituents in all phases. J. S. G. T.

5106. Vapour Line of the Three-Phase Conditions for the Coexistence of Two Solid Components with Vapour in a Binary System. A. Smits and E. J. Harmsen. *K. Akad. Amsterdam, Proc.* 35. 5. *pp.* 700–705, 1932. *In German.*—Wuite has stated that the connection of the coexisting vapour with the solid components of a binary system moves towards the side of the liquid component with lowering of temperature. The present paper discusses this theoretically, and it is shown that in the range where the vapour behaves as an ideal gas the molecular heat of sublimation is greatest for the least fluid substance. The Wuite conclusion stated above is therefore verified. S. G. B.

5107. History and Analytical Expression of the First and Second Laws of Thermodynamics and the Rôle of the Differentials dW and dQ. G. Tunell. *J. Phys. Chem.* 36. *pp.* 1743–1771, *June*, 1932.—The author discusses Clausius' contributions to the founding of thermodynamics as a science. In the formulations of the fundamental principles given in current text-books full use is not made of the symbols, forms and theorems in the theory of functions of real variables best suited to the problems. These symbols and forms are essentially those of Clausius, and these are discussed at length in this paper. Extracts from Kelvin's statement of the history of the first and second laws of thermodynamics are given in an Appendix. J. S. G. T.

5108. Important Properties of a System of Thermodynamics. M. Randall. *Zeits. f. Elektrochem.* 38. *pp.* 676–680, *Aug.*, 1932.—Notes eight points to be attended to in the presentation of thermodynamics, considered largely but not entirely from a pedagogic point of view. Among these points are the choice of symbols, and in this case definite recommendations are made. Attention is also directed to the chaotic form in which data are presented, and the difficulty of inserting numerical values in many formulæ without modification. J. H. A.

SOUND.

5109. Velocity of Sound in Nitrogen Gas. W. H. Keesom and J. A. v. Lammeren. *K. Akad. Amsterdam, Proc.* 35. 6. *pp.* 727–736, 1932. *Comm. No.* 221*c from the K. Onnes Lab., Leiden.*—The velocity of sound in nitrogen gas has been measured in the temperature-range extending from 0° C. down to liquid nitrogen temperatures, in dependence on the pressure. Four resonators were used to get an idea of the validity of the formula of Kirchhoff–Helmholtz. This formula gave good results. A curve $B = f(1/T)$, B being the second virial coefficient, has been calculated holding from 150° down to 80° K. Also the ratio c_p/c_v and the specific heats c_p and c_v were calculated. AUTHORS.

5110. Velocity of Sound in Paper. D. A. Oliver. *Phil. Mag.* 14. *pp.* 318–328, *Aug.*, 1932.—By clamping a strip of paper at one end and measuring its natural frequency of vibration a measure of its dynamical modulus of elasticity may be obtained. To measure this frequency the paper was attached to the armature of a moving-iron loud-speaker movement and the resonant frequency observed. The method was checked by using phosphor bronze of known elasticity. The resonant frequency of the paper was found to be independent of its width. The results were checked by static deflection. J. E. R. C.

5111. Propagation of Elastic Waves in Materials under High Hydrostatic Pressure. H. Hencky. *Phil. Mag.* 14. *pp.* 254–258, *Aug.* 14, 1932.—This mathematical paper contains an investigation of the influence of an existing hydrostatic stress on the velocity of sound waves, the corrections for the velocities of propagation being derived. H. H. Ho.

5112. Passage of Sound through Small Openings. E. Wintergerst and W. Knecht. *V.D.I.* 76. *pp.* 777–779, *Aug.* 6, 1932.—Sounds of varying frequency were passed from a loud-speaker into a tube, and were tested before and after passing through holes in a partition by means of a condenser microphone set. A quantity called the effective area f_w is used to denote the sectional area of the equivalent cylinder of wave energy transmitted through the opening, and f the actual area of the opening; q is the ratio f_w/f. For a single circular hole 3 to 12 mm. in dia. in a brass plate 1 mm. thick, q diminishes from 70 to 2 as the frequency increases from 100 to 2000. When more holes are used, two holes transmit almost as much sound as one hole of twice the diameter, three nearly as much as one hole of thrice the diameter, *i.e.*, q increases rapidly with the number of apertures. The effects of slits and tubular holes in thick walls are also investigated; in the second case resonance appears, and it is pointed out that the principal tone in the noise of a machine may be screened by making holes of length, ¼, ¾, etc., of the wave-length of the tone in question, in the separating wall. G. E. A.

5113. Coefficient of Absorption of Sound in Tubes. F. Canac. *Rev. d'Acoustique,* 1. *pp.* 52–68, *March,* 1932.—An experimental study of the variation with frequency of the coefficient of acoustical absorption per unit length in tubes of rubber, wire-bound rubber and flexible metal. The method consists of equalising by ear the intensities of a pure note as heard through a system containing the tube under test and a comparison tube in which the intensity may be varied by moving one end to different positions in a stationary sound wave. Each coefficient is determined from a straight-line plot, and graphs of this quantity against the wave-lengths of the notes employed resemble rectangular hyperbolæ, which show that tubes may act as low-pass filters, and further indicate that absorption decreases with tube rigidity and diameter. E. J. I.

5114. Absorption of Sound in Tubes and Huts. Y. Rocard. *Comptes Rendus*, 195. *pp.* 112–114, *July* 11, 1932.—In tubes of the same dimensions the absorption depends on the nature of the walls. Taking the adiabatic equation in the form $pv^{\gamma+i\Delta\gamma} =$ const., an equation of propagation of sound in a hut with absorbing walls is obtained which differs from the classic equation of Rayleigh in having the factor $\gamma/(\gamma + i\Delta\gamma)$. An expression is also found for the coefficient of absorption in tubes. G. E. A.

5115. Factors which Affect the Measurement of Sound Absorption. V. L. Chrisler and Catherine E. Miller. *Bureau of Standards, J. of Research*, 9. *pp.* 175–185, *Aug.*, 1932.—It has been found that air has an appreciable absorption for sound at frequencies as low as 512 $\sim$. This absorption varies with the temperature, the moisture content and the barometric pressure. Curves are given showing such changes in absorption in the reverberation room at the Bureau of Standards. Attention is called to the fact that when a highly absorbent sample is placed in a very reverberant room the decay curve may not be logarithmic. AUTHORS.

5116. Weight as a Determining Factor in Sound Transmission. P. E. Sabine. *Acoustical Soc. of America, J.* 4. 1. *pp.* 38–43, *July*, 1932.—The fact of the predominating part played by the weight per unit area in the reduction of sound by walls of masonry materials was first pointed out by the author in 1923. Since then work carried out in other laboratories has confirmed these views, and the data from these sources are published in this paper. There is also included the theory of the transmission of sound by a partition, *e.g.*, a sound-proof door, and hitherto unpublished data are given on such doors. The effect of the inclusion of steel sheaths and lead linings is considered, and measured, and it is pointed out that segmental vibrations cause variations between the above theory and practice. The data obtained support the view that the transmission of sound by impervious single partitions is a case of forced vibrations. The application of the theory to masonry materials is criticised, and the effect of the threshold crack upon the sound insulation of a door is measured and discussed. G. A. V. S.

5117. Acoustical Properties of Parabolic Mirrors. K. Sato and M. Sasao. *Tokyo Univ. Aeronaut. Research Inst., Report No.* 83. *pp.* 19–63, *Aug.*, 1932. *English Abstract.*—The experiments were performed in a set of rooms which consisted of one heavily damped room communicating with another in which sound is generated by an organ blown from a constant-pressure device. The range of frequencies used extended from c^1 to a^4. The intensity of sound was determined by a Rayleigh disc with appropriate resonator to which the sound was conducted by a long rubber tube. Three parabolic mirrors, of different curvatures and of 40 cm. dia., constructed from aluminium 2 cm. thick, were used at about 6 m. from the above-mentioned aperture, and the incident waves were assumed to be approximately parallel. The following experiments were performed: (1) the fluctuation of intensity along the axis of the mirror was measured, and shows that very little focussing effect occurred for frequencies below c^4; (2) a determination of the effect of curvature of the mirror was made; (3) the distribution of intensity in a plane perpendicular to the axis was observed and an involved interference pattern obtained; (4) the contour lines of equal intensity were plotted, and show that while for long wave-lengths the interference effects are not very marked, a very complicated pattern could be obtained for such a frequency as c^4. Finally, the magnifying power of the mirrors for different wave-lengths was determined, and it is shown that it increases with decreasing wave-length, and is much smaller than for a conical horn of the same opening and depth.

J. E. R. C.

5118. Electro-Acoustic Lissajous Curves. Z. Carrière. *J. de Physique et le Radium*, 3. *pp*. 355–372, *Aug*., 1932.—Lissajous curves were obtained by compounding the acoustic velocity of electrified powder vibrating at the mouth of a resonating tube with a periodic velocity at right angles produced and maintained by an alternating electric field. Synchronism of the two velocities was effected very simply by deriving the alternating electric field from the alternator employed to excite the telephone receiver serving as the source of sound at the end of the tube. The octave curves obtained in this way may be used to study the variations of phase in the resonating tube caused by variations from the normal form, as in the case of branch tubes, thin walls, bends, contractions, etc. The elliptical unison curves are deformed when the electrodynamic loudspeaker used as the sound source has in its circuit e.m.f.s which are not sinusoidal, or reactances variable with the intensity. Reciprocally the apparatus may be used as an oscilloscope or even as an oscillograph. A. W.

5119. Motion of an Organ-Pipe Reed. L. Auger. *Comptes Rendus*, 195. *pp*. 516–518, *Sept*. 5, 1932.—An image of the reed of an organ pipe is photographed, and its movements recorded when excited under different wind pressures. If the reed alone is excited, the frequency increases with the pressure. When the reed is connected with an 8-ft. pipe, a good musical note is produced by pressures between 80 and 100 mm., while between 100 and 340 mm. a sharp note, and between 340 and 400 mm. a noise, is produced. Above this pressure the note again becomes musical at an octave higher, although the original note occasionally breaks in.

J. P. A.

5120. Vibrations of Rods and Plates. R. C. Colwell. *Frank. Inst*., *J*. 214. *pp*. 199–213, *Aug*., 1932.—The differential equation of a membrane with fixed edges is derived from those for two rods or wires at right angles to each other and fixed at their ends. By a similar process the equation for a Chladni plate is found. With a valve oscillator new figures have been obtained which correspond to given values of the constants of the equation. Also photographic reproductions are given of the nodal lines of a square brass plate in which different figures are obtained by changing the constants while keeping the frequency practically unchanged. [See also Abstract 169 (1932).] G. E. A.

5121. Magnetoelastic Effect of a Vibrating String. O. v. Auwers. *Zeits. f. Physik*, 78. 3–4. *pp*. 230–239, *Sept*. 21, 1932.—On connecting a vibrating string to a loud-speaker, with or without interposing a transformer, a musical tone is heard. This phenomenon, first described by v. Hippel and Stierstadt, was at first attributed to the centrifugal action of sound waves on electrons. The author shows that it only occurs in strings having a remanent ferromagnetism, and is due to currents induced in the necessary loop. E. E. F. d'A.

5122. Acoustic Resonator Interferometer. Part II. Ultrasonic Velocity and Absorption in Gases. J. C. Hubbard. *Phys. Rev.* 41. *pp.* 523–535, *Aug.* 15, 1932.—The derivation of the equivalent electric network of the acoustic resonator interferometer in Part I of this paper [see Abstract 167 (1932)] has made it possible to develop the theory for the current in a simple resonant circuit in which the electrodes of the piezoelectric plate of the interferometer are connected to the terminals of the variable condenser of the circuit. The special case of this theory in which the circuit is excited at a constant frequency determined by the crevasse frequency of the resonator plate in its given situation with respect to electrodes and associated circuit, when the acoustic path in the interferometer is detuned and the resonant circuit is tuned so that its resonant maximum occurs at the same frequency, takes an especially simple form and leads to a direct procedure for determination of ultrasonic velocity and absorption in a gas in terms only of current in the resonant circuit and path-length in the interferometer, all circuit and interferometer constants dropping out. The values of current as a function of path-length obtained experimentally are in complete accord with the theory, and data for ultrasonic absorption in air and in CO_2 so far obtained are in agreement with the meagre data available by other methods. The rôle of the coefficient of reflection at the fluid-reflector surface is discussed. AUTHOR.

5123. Supersonic Dispersion and Absorption in CO_2. W. H. Pielemeier. *Phys. Rev.* 41. *pp.* 833–837, *Sept.* 15, 1932.—Since supersonic velocity determinations in air near a crystal oscillator usually yield values in excess of the accepted value, $V_0 = 331 \cdot 6$ m./sec., a similar effect with CO_2 was suspected. The velocity and the absorption coefficient were measured at frequencies beginning in the dispersion region, theoretically and experimentally investigated by Kneser [see Abstract 1675 (1932)], and extending beyond it to 2·09 megacycles. The author's velocity values are slightly less than Kneser's experimental values, but they fit his theoretically determined dispersion curve equally well. At the lowest frequency tested (303 kc.) the absorption coefficient was found to exceed, by the greatest amount, its value computed from Lebedew's formula. This frequency is near the middle of the dispersion region where maximum absorption is expected. According to Pierce the absorption becomes excessive also when this frequency is approached from lower values. The results are presented in tabular and in graphical form. A sharp absorption maximum appears at 217 kc. [See also Abstract 526 (1932).] AUTHOR.

5124. Period of Adjustment of Vibrational Energy in CO_2 and N_2O. H. O. Kneser and J. Zühlke. *Zeits. f. Physik*, 77. 9–10. *pp.* 649–652, *Aug.* 24, 1932.—Sound dispersion occurs in N_2O similar to that observed in CO_2 [see Abstract 1675 (1932)], and is in quantitative agreement with the assumption that the period of adjustment of the heat of vibration is of the order 10^{-6} sec., and hence comparable with the period of the sound vibrations. It may be derived from the dispersion curve of N_2O

that the part of the heat of vibration which is caused by transversal deformation of the molecule is alone responsible for the dispersion.

G. E. A.

5125. Sound Receivers. J. Perrin. *Rev. d'Acoustique*, 1. *pp.* 9–27, *March*, 1932.—An account of those sound receivers with whose development the author has been associated together with some notes on the sense of direction of sound and the sensitivity of the ear. The instruments concerned include disc-shaped resonators and geophones, and single and multiple horns. E. J. I.

5126. Pressure-Receivers and Displacement-Receivers. K. Schuster. *E.N.T.* 9. *pp.* 235–258, *July*, 1932.—Discusses three current definitions of the idea of the pressure-receiver and the displacement-receiver, and prefers the following, given by Waetzmann. A pressure-receiver when moved in a plane stationary wave system shows the maximum indication in a pressure antinode and no deflection at all in a displacement antinode. A displacement-receiver shows its maximum deflection in a displacement antinode and no deflection at all at a pressure antinode.

W. H. Ge.

5127. Resonance in Small Rooms. V. O. Knudsen. *Acoustical Soc. of America, J.* 4. 1. *pp.* 20–37, *July*, 1932.—The frequencies, n, of vibration of air in a parallelepipedical room are given by the equation $2n = c(p^2/l_1^2 + q^2/l_2^2 + r^2/l_3^2)^{1/2}$, where l_1, l_2, l_3 are the dimensions of the room, and p, q, r are integers, the vibrations of which the direction is perpendicular to a wall covered with absorptive material vanishing. This equation is confirmed by 269 oscillograms obtained in a room 8 ft. by 8 ft. by 9·5 ft. by means of steady tones of varying frequency; a number of these are reproduced. The results show that the reverberation in such a room consists of the free damped vibrations of the air in the room: for measurements a pure tone is essential (the higher harmonics exciting one or more of the free vibrations whose damping rates will dominate the rate of decay of the reverberation), and a band-pass filter in the detector circuit is advisable; the quality of all sounds is affected by the resonant properties of the room, and the pitch may change perceptibly during the decay of the tone; transmission measurements of sound through a partition from a source- to a test-room may be seriously affected by their respective resonant properties; resonance effects in small rooms can be partially overcome by rotating suitable vanes in the rooms. [See Abstract 209 (1931).]

C. A. S.

5128. Combined Reverberation Time of Electrically Coupled Rooms. A. P. Hill. *Acoustical Soc. of America, J.* 4. 1. *pp.* 63–68, *July*, 1932.—The rate of decay of sound in a room where its normal rate of decay is exponential when the source of sound itself is cut off exponentially is given by the equation $(T_1e^{-\phi_1 t} - T_2e^{-\phi_2 t})/(T_1 - T_2)$, where T_1, T_2 are the individual reverberation times of the rooms. This gives results in satisfactory agreement with experimental sound-intensity decay curves at 500 ∼ for three rooms with individual reverberation times of 0·56, 0·54 and 9·1 sec., the first room being electrically coupled with the second and the third giving reverberation times of 0·68 and 9·0 sec. respectively.

C. A. S.

5129. Modified Reverberation Formula. G. Millington. *Acoustical Soc. of America, J.* 4. 1. *pp.* 69–82, *July*, 1932.—Eyring's modification of Sabine's formula has been found to give absorption coefficients greater than 1 in some cases and the author puts forward a corrected formula. Eyring's formula is wrong in that it is based upon the assumption that at each reflection the sound is reduced to $(1 - a)$ times its incident intensity; this is only true provided that the sound is at each reflection scattered in all directions. The author, assuming a regular reflection law, deduces the formula: $T = -0\cdot05V/\Sigma s_1 \log_e (1 - a)$, where T is the reverberation time, V = volume of the room, and S_1, S_2 . . ., are the areas of the different absorbing surfaces of which the absorption coefficients are a_1, a_2, . . . The formula is applied to some results originally given by Eyring, and shown to produce more reasonable values for the absorption coefficients. The particular case of a rectangular room is studied in detail, and the results shown to be in accord with the statistical theory adopted for the deduction of the general formula. J. E. R. C.

5130. Articulation and Optimum Reverberation in Auditoria. A. Hirayama. *I.E.E., Japan. J.* 52. *pp.* 576–581, *and* 582–585, *Aug.*, 1932. *English Abstract.*—The optimum acoustic conditions for auditoria are obtained from a theoretical study of speech articulation in rooms. From certain assumptions it is found that T_0, the optimum reverberation time for speech and music, is given by $T_0 = 0\cdot24H$, where H is the mean height of the room above the seats. Also, if P_0 is the optimum mean power of the source, $P_0 = \text{const.} \times F$, where F is the area occupied by the audience. In the second paper the theoretical equations are discussed with reference to eighteen auditoria in England and Germany. In place of H, the volume per seat, V/N, is taken, and T_0 is graphed with V/N, from the theoretical equation for an empty room $T_0 = 0\cdot432$ V/N, then from actual examples for halls respectively full and one-third full. All three graphs are straight lines through the origin. A room for which the reverberation time varies with *n* the number of listeners according to the equation $T_0 = \{0\cdot432 - 0\cdot152(n/N)\}V/N$ is regarded as having the ideal reverberation time, and halls satisfying this condition are: Aeolian Hall, London; Conservatorium, Leipzig; Welwyn Theatre, Herts; White Rock Pavilion, Hastings; Apollo Theatre, Chicago; Smith Concert Hall and Eastman Theatre, Rochester. G. E. A.

5131. A New Method of Sound-Pulse Photography. S. Kalyanaraman. *Journ. Sci. Instruments*, 9. *pp.* 284–285, *Sept.*, 1932.—Sound-pulse photography as an aid to the study of the acoustics of auditoria has been perfected by Sabine and others using large electrostatic machines capable of developing voltages of the order of 100,000 volts. The author in trying that method has found that it is not possible to use electrostatic machines for developing such large voltages continuously in damp places such as the tropics. A new method of photography is described in which an induction coil replaces the electrostatic machine. AUTHOR.

5132. Gramophone Tracking. F. Record. *Journ. Sci. Instruments*, 9. *pp.* 286–289, *Sept.*, 1932.—A geometrical note on the subject of the tracking of a gramophone needle. AUTHOR.

ELECTRICITY AND MAGNETISM.

ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM.

5133. Standards of Capacity. F. Bedeau. *Congrès International d'Électricité, Paris, Sect.* 2. *Rapport No.* 9. [24 *pp.*], 1932.—A description and discussion of the principal types of capacity and condenser. J. J. S.

5134. Conformal Representation in Electrostatics. E. Kehren. *Ann. d. Physik,* 14. 4. *pp.* 367–395, *Aug.* 1, 1932.—An accurate solution of various potential problems is obtained by means of the method of conformal representation. This is supplemented in some cases by graphical methods. J. J. S.

5135. Electrical Peculiarities of Dust and Mist. H. Sachsse. *Ann. d. Physik,* 14. 4. *pp.* 396–412, *Aug.* 1, 1932.—The method first used by Ehrenhaft and Millikan to determine the charge on particles of oil was applied to find the charge in the case of a number of kinds of smoke and mist and to investigate the relation between charge and magnitude of particles and the nature of their origin and previous treatment. The following results were obtained from experiments with the Millikan condenser and Faraday cage: (1) The diffused substances or aerosols As_2O_3 NH_4Cl, SO_3, $TiCl_4$, and paraffin oil got by condensation from the state of vapour are uncharged. (2) Aerosols obtained by dispersion into dust of liquid substances with air under pressure are likewise uncharged. (3) Aerosols obtained by other methods—explosion, combustion, whirling action with compressed air, so-called "friction"—are fully charged, apparently half + and half −. (4) The charges produced by "friction" are approximately proportional to the square root of the radius of the particle and carry about one-third of the maximum charge which a particle obtains in the negative field of a corona discharge (field strength 6·5 c.g.s. units). Thus an MgO particle of 1×10^{-4} cm. radius carries about 100 elementary charges. (5) The charge of the whole cloud depends as to magnitude and sign on the conditions of origin of the cloud and perhaps before all on the influence of friction at the origin. (6) By friction, charges of both signs and of great magnitude can be given to dust—*e.g.*, 30 e.s.u. per gm. J. J. S.

5136. Characteristic Temperature Point for Rochelle Salt Crystals. (Mrs.) R. D. Schulwas-Sorokin. *Zeits. f. Physik,* 77. 7–8. *pp.* 541–546, *Aug.* 6, 1932.—In the course of the curve showing the dependence of the piezoelectric and dielectric constants of Rochelle salt on temperature a very sharp maximum at 22·5° C. within a very small temperature interval was observed. In this respect the behaviour of Rochelle salt is similar to the behaviour of ferromagnetic bodies in fields of small strength. [See Abstract 2522 (1932).] J. J. S.

5137. Thickness Vibrations of Piezoelectric Oscillating Crystals. I. Koga. *Physics,* 3. *pp.* 70–80, *Aug.*, 1932.—Thickness vibrations are shown to be due to the standing waves produced by the interference of plane waves incident on and reflected from the plane boundary surfaces of the crystal slice. The theoretical results are verified by several examples of vibrations obtained with actual crystals. Three normal modes are found in the thickness vibration, the frequencies being given to a first approximation by the formula $P/2\pi = (q/2a)(c/\rho)^{0\cdot5}$, where q is any integer, a the thickness and ρ the density of the plate, and c an adiabatic elastic constant depending on the orientation of the plate with respect to the crystallographic axes. The formula gives results a little lower than those found experimentally. A. W.

5138. Infra-Red Oscillations and Dielectric Losses. M. Czerny and W. Schottky. *Zeits. f. Physik*, 78. 3–4. *pp.* 220–229, *Sept.* 21, 1932.—For a rock-salt crystal a dispersion formula can be used to calculate the damping in the region of the shortest Hertzian waves. Shows that dielectric losses attributable to this source may be expected in rock-salt. E. E. F. d'A.

5139. Phase-Boundary Potentials and Dielectric Constants. P. Farkas. *Zeits. f. Elektrochem.* 32. *pp.* 654–665, *Aug.*, 1932.—Determinations have been made of the dielectric constants of mutually saturated solutions of water and a number of organic solvents, the phase-boundary potentials of various salts dissolved in such pairs of solvents being also measured. The results obtained are interpreted in the light of an equation deduced by Debye. T. H. P.

5140. Temperature Dependence of the Dielectric Constant and Density of Nitrobenzene near the Melting Point. H. Braune and W. Giertz. *Zeits. f. phys. Chem.* 161. *Abt.A.* 4–5. *pp.* 389–394, *Sept.*, 1932.—The phenomena ascribed by Wolfke and Mazur [see Abstract 2483 (1932)] to a liquid phase transformation cannot be confirmed by the measurements now recorded. H. H. Ho.

5141. Polar Molecules. P. Debye. *Congrès International d'Électricité, Paris, Sect.* 1. *Rapport No.* 1. [12 *pp.*], 1932.—This very comprehensive discussion includes: the molecular interpretation of the dielectric constant; separation of deformation and orientation by a study of the effect of temperature; dispersion; separation of deformation and orientation by the study of dispersion; dipole moment and chemical constitution; solid bodies and the electrical analogy of ferromagnetism. H. H. Ho.

5142. Dielectric Polarisation of Nitroso-Compounds. R. J. W. le Fevre and J. W. Smith. *Chem. Soc., J. pp.* 2239–2245, *Aug.*, 1932. —The dielectric constants, refractive indices, and densities of dilute solutions of *p*-nitroso-dimethyl-, diethyl-, and monomethyl-aniline in benzene and in CCl_4 have been measured, and the corresponding electric dipole moments calculated. The results, along with previous data, are discussed with reference to the behaviour of the nitroso-group in organic compounds. The values for *p*-nitroso-diethyl- (μ, 7·18) and monomethyl- (μ, 7·38) appear to be the largest dipole moments yet reported for any organic compound. H. H. Ho.

5143. Polarisation Measurements on Basic Beryllium Acetate and Acetylacetonate. J. W. Smith and W. R. Angus. *Roy. Soc., Proc.* 137. *pp.* 372–379, *Aug.* 2, 1932.—The dielectric constants and densities of two solutions of basic beryllium acetate in benzene have been measured at 25° and 45° C. and molecular polarisations calculated. Molecular polarisations have been calculated for a solution of beryllium acetylacetonate in CCl_4 from dielectric constant and density measurements at 20°, 25°, 35° and 45° C. The molecular polarisations do not vary with temperature but are higher than the molecular refractivities; this is tentatively attributed to atomic polarisation, since in the series CCl_4, $TiCl_4$, $SnCl_4$, the atomic polarisations increase with the electropositive character of the central atom. The high value for the atomic polarisation seems to indicate that the structural formula in which all the atoms are electrically neutral is not an adequate representation of the molecule. From the fact that beryllates exist, and in view of the marked similarity in behaviour between Be and Al compounds, it may be supposed that certain Be compounds are amphoteric in character so that a charge of -2 on the Be atoms would not be unexpected. A formula in which normal 2 and 4 electron linkages are used is advocated. H. H. Ho.

5144. Dielectric Behaviour of Dipole Liquids. A. E. van Arkel and J. L. Snoek. *Phys. Zeits.* 33. *pp.* 662–664, *Sept.* 1, 1932.—An empirical variation of Debye's formula is discussed. J. J. S.

5145. Dipole Moments of Benzene Derivatives with Freely Rotating Substituents. H. L. Donle and K. A. Gehrckens. *Zeits. f. phys. Chem.* 18. *Abt.B.* 4–5. *pp.* 316–326, *Aug.*, 1932.—The dipole moments (μ) of the following benzene derivatives with freely rotatable groups have been determined: phenol (1·54), phenol + 0·43 % H_2O (1·77); *o*- (1·30), *m*- (2·10), *p*- (2·22) chlorophenol; *p*-bromophenol (2·12); *o*- (1·41), *m*- (1·54), *p*- (1·57) cresol; *o*- (1·57), *m*- (1·43), *p*- (1·27) toluidine; *o*- (1·45), *p*- (1·87) anisidine; *o*- (4·81), *p*- (4·75) nitroanisole; *p*-nitrophenol (5·01); 2 : 4 : 6-trichlorophenol (1·62); 2 : 4 : 6-tribromophenol (1·56). The size of the angle of the group moment relative to the relevant benzene diameter has been established, and the previous value for phenol of 75° ± 15° changed to 89° ± 5°. The agreement between the calculated and observed values for the substituted phenols is satisfactory. H. H. Ho.

5146. Dipole Moments of Aromatic Compounds. W. Bodenheimer and K. Wehage. *Zeits. f. phys. Chem.* 18. *Abt.B.* 4–5. *pp.* 343–346, *Aug.*, 1932.—The following measurements for μ are recorded: *o*-chlorobromo-benzene in benzene (2·21), in hexane (2·23); *m*-chlorobromo-benzene in benzene (1·51), in hexane (1·53); *p*-chlorobromo-benzene in benzene ($<0·04$); phenylmethylcarbinol in hexane (1·55), in benzene (1·60); benzyl alcohol in benzene (1·68). The measurements show that a measurable solvent influence does not exist. H. H. Ho.

5147. Electric Moment and Molecular Structure. Part IX. Oxygen and Sulphur Valence Angles. C. P. Smyth and W. S. Walls. *Am. Chem. Soc., J.* 54. *pp.* 3230–3240, *Aug.*, 1932.—The electric moments of para-substituted diphenyl ethers and a sulphide, an anisole, a phenetole and heterocyclic compounds have been determined and used, together with other moments [see Abstract 4481 (1932)], to study the angles between the valencies in the O and S atoms. The O angle in the diphenyl ethers is 121 ± 5°, but the results for the anisoles and phenetoles, which indicate around 135°, are not dependable. Limited data give about 146° for the S valence angle in the diphenyl sulphides, although this may be too high. The O valence angles in furan and tetrahydrofuran, calculated from the interatomic distances, vary from 65° to about 140°, and the moments are in excellent qualitative agreement with the predictions based on the size of the angles. The behaviour of thiophene is strictly analogous to that of the corresponding O compound. H. H. Ho.

5148. Electric Moments of Acetone, Acetaldehyde, Acetylchloride, Chloroacetone and Chloroacetylchloride C. T. Zahn. *Phys. Zeits.* 33. *pp.* 686–687, *Sept.* 15, 1932.—The measurements now recorded had the dual objective of (*a*) testing the degree of accuracy of the Eucken and Meyer method for the calculation of the dipole moments of molecules containing the large $C = O$ moment and (*b*) for the qualitative estimation of how far the free rotation of these molecules is hindered by internal molecular forces. The observed moment of acetyl chloride is 2·68 and the calculated value only 2·28, so that either a deformation of the tetrahedral symmetry occurs or the value 2·3 for the $C = O$ moment is too small, or that both circumstances are involved. H. H. Ho.

5149. Present Knowledge of Cosmic Rays. R. A. Millikan. *Congrès International d'Électricité, Paris, Sect.* 1. *Rapport No.* 5. [18 *pp.*], 1932.—A discussion of the place of origin of cosmic rays and their nature. From the uniformity of distribution it is concluded that the cosmic rays are produced in interstellar space and originate from the reconstruction of atoms. J. J. S.

5150. Energies of Cosmic-Ray Particles. C. D. Anderson. *Phys. Rev.* 41. *pp.* 405–421, *Aug.* 15, 1932.—Cloud chamber photographs of cosmic-ray tracks in a magnetic field up to 17,000 gauss are shown. On the assumption that the particles producing the tracks are travelling downward through the chamber rather than upward, particles of positive charge appear as well as electrons. From the specific ionisation along the track it is concluded that the positives are protons, and are not nuclei of charge greater than unity. No evidence is uncovered demanding the introduction of a neutron for cosmic-ray phenomena. Eight examples of associated tracks are shown. Energies range from below 10^6 electron-volts to values in a few cases of the order of 10^9 electron-volts. Energy values for 70 tracks are listed. The scattering of cosmic particles in traversing a 6·0 mm. lead plate is measured. AUTHOR.

5151. Interpretation of Cosmic-Ray Phenomena. T. H. Johnson. *Phys. Rev.* 41. *pp.* 545–552, *Sept.* 1, 1932.—Schindler's data on the transition effects of the cosmic rays have been interpreted on the assumption that the equilibrium between the primary radiation and its secondary corpuscular rays is different in different media. The ionisation behind any thickness of absorbing materials, assumed to be proportional to the flux of secondaries, is calculated in terms of the absorption coefficients, $\nu(m)$, of the primary radiation and the production and absorption coefficients, $\beta(m)$ and $\mu(m, m)$, respectively, of the secondary rays, these coefficients being characteristics of the media. A comparison with the data permits a determination of each of the absorption coefficients as well as the product of each of the production coefficients by the number of primary rays. The results are as follows, expressed in cm.$^{-1}$ lead equivalent: $\nu(\text{Pb}) = 0{\cdot}0064$; $\nu(\text{Fe}) = 0{\cdot}009$; $\mu(\text{Pb, air})$, the absorption coefficient in lead for secondaries produced in air $= 0{\cdot}50$; $\mu(\text{Pb, Pb}) = 0{\cdot}98$; $\mu(\text{Fe, air}) = 0{\cdot}30$; $\mu(\text{Fe, Fe}) = 0{\cdot}45$; $\mu(\text{Pb, Fe}) = 0{\cdot}72$; $\mu(\text{Fe, Pb}) = 0{\cdot}48$; $\beta(\text{Pb})/\beta(\text{Fe}) = 2{\cdot}0$. This determination of the absorption coefficients of the primary and secondary radiations allows the following estimates to be made. (*a*) The lower limit of the average energy of the secondary radiation is about 30 million volts. (*b*) The average number of secondaries per primary is about 100 in iron and 230 in lead. (*c*) The energy of a primary cosmic ray, equal to the sum of the energies of its secondaries, is about 2×10^{10} volts. AUTHOR.

5152. Cosmic Radiation. G. Hoffmann. *Phys. Zeits.* 33. *pp.* 633–662, *Sept.* 1, 1932.—A review of the course of investigation of cosmic radiation, including a description of the methods of measurement, an account of the results of the measurements and a theoretical discussion. References are given to 307 papers. J. J. S.

5153. Cosmic Ray Coincidences. L. Tuwim. *Zeits. f. Physik*, 76. 7–8. *pp.* 561–564, *June* 20, 1932.—It is shown that according to the mathematical theory of cosmic ray coincidences and of the vertical counter-tube effect for cosmic rays, the resolving power of an arrangement of counter tubes is not given by the space angle of the counter tubes, as would be expected neglecting the counter-tube effect. The resolving power can in fact be raised to an arbitrarily high value with increase of the accuracy of measurement. Barnóthy and Forró's work on the effect of the earth's magnetic field on cosmic radiation is criticised in the light of the author's mathematical theory of cosmic ray coincidences in counter tubes [see Abstract 2530 (1932)]. W. S. S.

5154. Vertical Counter-Tube Effect of Cosmic Radiation. L. Tuwim. *Zeits. f. Physik*, 77. 11–12. *pp.* 815–817, *Sept.* 3, 1932.—Some general remarks on the limits of the validity of the recently published mathematical theories of the vertical counter-tube effect of the cosmic radiation and of the cosmic radiation coincidences. J. J. S.

5155. Pressure-Dependence of the Ionisation due to Cosmic Radiation. B. Gross. *Zeits. f. Physik*, 78. 3–4. *pp.* 271–278, *Sept.* 21, 1932.—An equation is given for the course of the ionisation current at high pressures with consideration of the dependence on pressure of the ionic constants and taking into account the general spatial recombination on the basis of Jaffé's theory. The agreement with experiment appears satisfactory. J. J. S.

5156. Ionisation Charts of the Upper Atmosphere. G. Millington. *Phys. Soc., Proc.* 44. *pp.* 580–593, *Sept.* 1, 1932.—In this paper Chapman's theory [see Abstract 1819 (1931)] of the ionisation of the upper atmosphere by solar radiation has been applied to construct a set of charts giving contour lines of equal ionic density over the surface of the earth. A simple approximate method of solving the fundamental differential equation of the theory by a rapid arithmetical process is described. Charts are drawn for winter, equinox and summer conditions for the values 0·5 and 1 of the parameter σ_0 and the value 150 of the parameter R. A brief comparison of these charts with existing empirical charts is given with a short discussion of its practical and theoretical significance. AUTHOR.

5157. Auroræ at a Height of less than 80 Kilometres. L. Harang and W. Bauer. *Gerlands Beitr. z. Geophys.* 37. 1. *pp.* 109–115, 1932.—Some 500 parallactic photographs of auroræ were taken at Tromsö and Tennens (43·4 km. apart) on March 8–9, 1932. Among them several taken about 20 h. 46 m. of a green auroral arc with dark red lower edge indicated extension down to 65 km. The appearance is described. [See Abstract 3381 (1932).] C. A. S.

5158. Significance and Accuracy of Measurements of Earth-Current Potentials. W. J. Rooney. *Terr. Mag.* 37. *pp.* 363–374, *Sept.*, 1932.—The superficial simplicity of measurements of earth-current potentials makes them liable to error due to inadequate appreciation of the requirements for securing satisfactory records and has led to faulty interpretation of the results obtained. Records from the multiple systems at Watheroo and Huancayo demonstrate the lack of significance of the absolute values of potential recorded and of the long-period changes in them, most of which are due to meteorological conditions. The value of independent records as a check on the satisfactory operation of the recording equipment and as an indication of anomalous results due to local structural inhomogeneity is shown by examples taken from the records from these two observatories. Duplicate potential records and earth-resistivity data both are essential for adequate study of the phenomenon. AUTHOR.

5159. Magnetic Activity—Numerical Magnetic Character of Days. C. R. Duvall. *Terr. Mag.* 37. *pp.* 261–268, *Sept.*, 1932.—A table of monthly, equinoctial, solstitial and annual means of the new measure is given for 1930 and 1931 at 17 observatories. Curves of the monthly means are given which show (1) good agreement in the time of maxima and minima at the different observatories; (2) the difference in value and range in value at the different observatories, the far northern observatories having large values, those near the equator small; (3) the decrease in amplitude for 1931 as compared with 1930; this decrease is very nearly in the same proportion as the corresponding decrease in sunspot-numbers. The question of reducing the amplitudes of the new measure to a common basis is discussed. A table of statistics of the 17 observatories and of the new measure is given to aid in this discussion. No satisfactory result is arrived at, and it appears questionable whether such a result is possible. The monthly means of the new measure are analysed for both years at the 17 observatories and the results given in a table. A discussion of this table and a comparison with some results given by Chree lead to the conclusion that a seasonal variation in the new measure is well established. AUTHOR.

5160. Statistical Methods for Research on Diurnal Variations. J. Bartels. *Terr. Mag.* 37. *pp.* 291–302, *Sept.*, 1932.—It is explained that research on the variability of the diurnal variations is necessary, because the usual method of discussing the average variations alone leads to omission of characteristic features of the phenomenon. The use of harmonic dials for this purpose is described, and the formulæ for numerical and graphical work are given. The use of the two-dimensional standard deviation and of the probable ellipse for estimating the accuracy of average diurnal variations is explained. The procedure is applied to the diurnal variation of declination on quiet days at Huancayo Observatory in southern summer, and the results are discussed. The variability is surprisingly large and affects both amplitudes and phases of the sine-waves. Some days with particularly large and small amplitudes are picked out. Preliminary results of similar calculations for Watheroo Observatory are summarised, among others the remarkable dial for the 24-hourly wave in horizontal intensity, which indicates that the focus of the diurnal atmospheric current-system passes on some days north, on other days south of Watheroo. Some remarks on future work are added. AUTHOR.

CURRENT ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM.

5161. Standards of Resistance. H. Steinwehr. *Congrès International d'Électritité, Paris, Sect.* 2. *Rapport No.* 5. [16 *pp.*], 1932.—A description of measurements of the mercury ohm and wire resistances. Those chiefly dealt with are the methods worked out at the Reichsanstalt, others being briefly referred to, especially as to the points in which they differ. J. J. S.

5162. Resistance of Nickel in Transverse Magnetic Fields at Various Temperatures. A. Drigo. *N. Cimento,* 9. *pp.* 201–223, *July,* 1932.—The changes in resistance of a nickel wire 0·1 mm. dia. and 50 cm. long have been studied at temperatures up to about 420° C. (*i.e.*, above the Curie point) and in fields up to 1600 gauss. The wire was better than 98 % purity, and was annealed after being coiled into a plane spiral for insertion in the magnetic field. The resistance changes were measured with a modification of the Thomson double bridge. The resistance passes through a maximum at a field of about 800 gauss and then gradually diminishes, being equal again to the " no-field " value at about 1350 gauss. The increase, however, may be due to inexact setting of the specimen in relation to the field. Above the Curie point, the resistance diminishes without passing through a maximum. The effect of hysteresis varies with temperature. The results are discussed, and slight modifications of Gerlach's theory (which was put forward in connection with longitudinal fields) are suggested. J. H. A.

5163. Resistance-Temperature Relation of Beryllium Oxide and Zinc Oxide. J. A. Osteen. *Physics,* 3. *pp.* 81–89, *Aug.*, 1932.—Bidwell [see Abstract 1152 (1916)] showed that the resistance-temperature law for certain variable conductors (oxides, etc.) was of the form $\rho = Ae^{Q/RT + aT}$. Plotted in the form $(1/\rho)(d\rho/dT) = Q/RT^2 - a$, he obtained for Fe_2O_3 straight lines with a break near the recalescence point, the two lines having the same *y* intercept but different slopes. This law was also followed by metallic germanium. The present paper extends this work to zinc oxide and beryllium oxide. Beryllium oxide yields a straight line showing a transition at 750° C. Zinc oxide yields two straight lines with a transition in the interval 250° to 500° C. The two zinc oxide lines have different slopes but the same *y* intercepts. With successive heatings to 1050° C. there occur continued decreases in the slope of the line for the 500° to 1000° C. range but no change in the *y* intercept. The line for the range 0° to 250° C. changes on successive heatings to 1050° C. and finally stabilises to a value of slope and intercept which repeats on succeeding runs. On the suggestion that the indicated transformation was due to impurity, new material of special purity was studied. The behaviour of this material was found to agree closely with that of the earlier specimen but gave a more clean-cut transformation. AUTHOR.

5164. Matthiessen's Constant and the Resistance-Temperature Coefficient of Metals. J. T. MacGregor-Morris and R. P. Hunt. *Phil. Mag.* 14. *pp.* 372–383, *Sept.*, 1932.—The fact that the electrical resistivity of a metal and its temperature coefficient are related was first noticed by Matthiessen in 1862. He stated the following law as holding in most cases: The absolute difference in the observed resistance between 0° and 100° C. of an alloy is equal to the absolute difference between the means of the resistance of the component metals between 0° and 100° C. This is one of two equivalent statements. The rule breaks down in the case of many alloys but is of wide applicability. The authors restate it in the following form: For the alloys of any particular metal with another the rate of increase of resistivity with temperature is independent of the concentration. That is dR/dT is the same for the various alloys. R_0 (resistivity at 0° C.) × temperature coefficient is also constant for the given alloys. The authors propose to call the law in this form Matthiessen's law and the constant the Matthiessen constant. The authors discuss this law and show its general applicability. A table of the constant for various metals is given, and exceptions are noted. An example of the practical value of the constant is the possibility of rapid prediction of the resistivity of a sample of commercially pure metal by finding its temperature coefficient. J. J. S.

5165. Conductivity of Dielectric Liquids. A. Nikuradse. *Phys. Zeits.* **33.** *pp.* **553–576,** *Aug.* **1, 1932.**—A review of the various researches carried out during many years past, including the most recent work on the subject of the characteristics of conduction in dielectric liquids. The portion of the subject dealt with in the present paper is the electrical conduction at low tensions, and it is considered under the following divisions: (1) Influence of the purity of the liquid; (2) Influence of the condition of the electrode surfaces; (3) Dependence of the current strength on time: (4) Spontaneous ionisation; (5) Ionisation by radiation; (6) The ionic constants; (7) Distribution of potential; (8) Phenomenon of polarity; (9) Influence of temperature; (10) Influence of pressure on the conductivity and on the ionic constants. A Bibliography is given. J. J. S.

5166. Conductivity of Oxide Coatings on Filaments. R. H. Fowler and A. H. Wilson. *Roy. Soc., Proc.* **137.** *pp.* **503–511,** *Sept.* **1, 1932.**—By applying Wilson's theory of semiconductivity and rectifying contacts, and Gurney's theory of electrolytic conduction, a satisfactory analysis of the observations is given. The conclusion is derived that the current is a mixed one, mainly electronic at high temperatures, and mainly electrolytic at low. E. E. F. d'A.

5167. Conductivity of Metals and Supraconductivity. W. J. de Haas and J. Voogd. *Congrès International d'Électricité, Paris, Sect.* **1.** *Rapport No.* **10. [41** *pp.***], 1932.**—A general account of the work carried out at Leiden, Toronto and Berlin, in connection with supraconductivity. Among the questions discussed are (1) whether the "ideal" resistance (apart from the effect of impurities, lattice distortion, etc.) becomes definitely zero at sufficiently low temperature, (2) the form of the temperature-resistance relation, (3) whether the transition in the ideal case is continuous or discontinuous, (4) the changes in other physical properties at the transition point, and (5) whether all metals would be supraconducting at sufficiently low temperatures. Work and general results on alloys are next described, and finally the effect of a magnetic field is described and discussed in some detail. J. H. A.

5168. Low Temperature H.F. Conductivity of Metals. J. C. McLennan. *Congrès International d'Électricité, Paris, Sect.* **1.** *Rapport No.* **11. [10** *pp.***], 1932.**—The absorption coefficient of lead for β-rays from mesothorium is unaltered on passing through the supraconducting transition point, and the same is true of its photoelectric emission and its absorption coefficient for visible light. The resistance of lead, tin and tantalum has been measured at frequencies up to 16 million ~, and it is found that the transition point falls with increasing temperature; by extrapolation, the phenomena of supraconductivity would not exist at frequencies of about 10^9 ~. It is concluded that some process with a relaxation time of the order 10^{-7} or 10^{-8} sec. is concerned in the phenomena. J. H. A.

5169. Electrical Properties of Silver Alloys. J. O. Linde. *Ann. d. Physik,* 14. 4. *pp.* 353–366, *Aug.* 1, 1932.—The atomic resistance increment of elements of atomic numbers 29–33, 46–51 and 78–83 in silver has been measured at 18° C. A few results are also given for the temperature coefficient of resistance. The atomic resistance increment for the above elements increases approximately proportionally to the square of their horizontal distance from silver in the periodic system. [See also Abstract 3910 (1931).] F. J. W.

5170. Changes in the Solid Phase of the System Copper-Gold. M. le Blanc and G. Wehner. *Ann. d. Physik,* 14. 5. *pp.* 481–509, *Aug.* 15, 1932.—An apparatus was constructed by means of which alloys of high melting points could be obtained in rod form for conductivity measurements. Such measurements were carried out for temperatures ranging up to 500° C. on a series of Cu-Au alloys. For pure Cu a secondary dependence of the electrical conductivity on the nuclear dimensions was found; this was not observed in the case of pure Au. The values of the conductivities of Cu-Au alloys quenched from high temperatures were found to lie on a **U**-shaped curve which is typical for mixed crystals. The measurements on tempered alloys below 450° C., under special conditions of stable equilibrium, gave a diagram of conductivity isothermals with three definite maxima, from which the existence is inferred of the three compounds Cu_3Au, Cu_3Au_2 and CuAu, which with excess Cu or Au atoms may result in mixed crystals. The results of the conductivity measurements were to a certain extent made more precise and confirmed by measurements of thermoelectric forces and by micrographic and X-ray investigation. A special discussion is given of the departures of the compounds from the stoichiometric relations and of the reaction mechanism of the compound CuAu. A. W.

5171. Uniform Distribution of Ingredients in Crystals during Tempering. B. Hochberg. *Zeits. f. Physik,* 77. 7–8. *pp.* 547–552, *Aug.* 6, 1932.—Reply to a criticism by F. Quittner [see Abstract 2540 (1932)] of the author's previous paper. It is shown that in tempered $NaNO_3$ crystals a space charge of constant density forms when a current passes through the crystals. Since it has been shown earlier that the space charge is determined by the concentration of the impurities, it is concluded that the process of tempering leads to a uniform distribution of the admixed components. The author points out weaknesses in the criticism of his statement that the deviations from Ohm's law are due to an irregular distribution of the impurities. H. L. B.

5172. Surface Layers in Carborundum Crystals. B. Claus. *Ann. d. Physik,* 14. 6. *pp.* 644–654, *Aug.* 30, 1932.—Early attempts to explain the phenomena of unilateral conductivity in crystals devoted attention to thermoelectric or to electrolytic effects, but recent work has tended to suggest that the effect is connected with the surface layers.

Carborundum was chosen because it is known that in its manufacture from Si and C, a certain amount of silica (SiO_2) is formed on the surface. The layer was studied chiefly with an exploring needle-point electrode, to determine the current-voltage characteristic, and its profile determined. The effect of etching the surface for varying periods is also reported. J. H. A.

5173. Electrical Conductivity and Thermoelectricity. A. Sommerfeld. *Congrès International d'Électricité, Paris, Sect.* 1. *Rapport No.* 9. [39 *pp.*], 1932.—A historical survey of the old electronic theory is given and the author then deals with the new theory founded on Pauli's exclusion principle, which is developed supposing the temperatures are very low, so that the electronic gas is completely degenerate. The theory is then completed thermodynamically, Fermi's distribution function being introduced. Electric and thermal conductivities are next dealt with, followed by thermoelectricity. All these questions are considered from the point of view of the corpuscular representation of the free electrons. Finally the effect of the lattice formed by the ions of the metal is considered, together with the electronic waves of wave mechanics. H. N. A.

5174. Theory of Thermoelectric Effects. W. Kroll. *Zeits. f. Physik*, 77. 5–6. *pp.* 322–332, *Aug.* 2, 1932.—It is shown in a mathematical calculation of the thermo-e.m.f. that the law of the exponential assimilation for the equilibrium distribution must be allowed to drop if it is desired to obtain the terms proportional to the third power of the temperature difference. J. J. S.

5175. Variation with Temperature of the Thermoelectric Power of Nickel and Some Copper-Nickel Alloys. K. E. Grew. *Phys. Rev.* 41. *pp.* 356–363, *Aug.* 1, 1932.—The thermoelectric power of pure nickel against platinum has been measured between 0° and 500° C.; similar measurements have been made on two nickel-copper alloys containing respectively 94 and 79 % nickel. A differential method was used in which the change in thermoelectric force ΔE corresponding to a small temperature change ΔT was observed. The results are discussed in relation to Stoner's theory [see Abstract 2047 (1931)]. Although the experimental results have the same general characteristic as those calculated, factors not considered in the simple theory are involved, even at temperatures at which the assumption that the magnetisation is due to spin moments only is approximately valid. AUTHOR.

5176. Thermoelectric Power of Single Crystal Bismuth Near the Melting Point. A. Soroos. *Phys. Rev.* 41. *pp.* 516–522, *Aug.* 15, 1932.—By investigating directly the thermoelectric power of bismuth single crystals near the melting point a transition region is found in which the thermoelectric power changes gradually from that characteristic of the solid to that characteristic of the final liquid state. The region extends from the melting point to about 8° above it. As an explanation it is supposed that a definite crystal structure persists into the liquid state. AUTHOR.

5177. Kathode Sputtering of Beryllium and Aluminium in Helium. P. D. Kueck and A. K. Brewer. *Rev. Sci. Instruments*, 3. *pp.* 427–429, *Aug.*, 1932.—An investigation is described which was made to see if Be is a better kathode than Al for investigating the He arc spectrum emitted in the Crookes dark space. A pyrex discharge tube 31 cm. long and 2·1 cm. dia. is used to compare the relative sputtering rates of the two metals, each being at opposite ends of the tubes and movable. Results show that the ratio of the absorbing powers of the films from Al and from Be is as 10 : 1. As the transparency is a measure of the usefulness of the kathode material, Be is ten times more desirable than Al; its melting point is also higher. H. M. B.

5178. Radiation Effect of Mercury Glow Lamps Without Voltage. H. Heyne, G. Meyer and A. Otto. *Zeits. f. techn. Physik,* 13. 9. *pp.* 407–408, 1932.—The effect previously described [see Abstract 1711 (1932)] was further investigated. It was found that the radiation from the lamp which produced the effect on the adjacent spark gap was mainly of wavelength 2536 Å. The emission of this radiation by the lamp under no-voltage is dependent on the concurrence of three principal factors: (i) Traces of one of the rare gases, such as argon, must be present in the lamp in addition to the mercury vapour. (ii) The lamp must be situated in an electric field, which in the case in question is that of the spark gap. (iii) At the same time suitable exciting radiation, such as ultra-violet radiation, must fall on the lamp. It is noteworthy that the secondary radiation from the lamp has appreciably greater intensity, at any rate as regards the effect on the spark gap, than the exciting radiation falling on the lamp. A. W.

5179. Electric Arcs with Several Negative Electrodes. M. Pierucci. *N. Cimento,* 9. *pp.* 196–200, *July,* 1932.—As an extension of previous work, the author describes methods of producing arcs with a number of negative electrodes. The positive is cored or solid carbon and about 5 to 7 mm. in diameter. As many as 8 negative carbons (5 mm. solid) can be arranged radially in a circle with its plane perpendicular to the axis of the positive. The arc is steady with cored carbons, and its spectrum lacks many of the Lockyer " long " lines. With solid carbons, the arc hisses, but is similar in other respects. In both cases, the positive electrode forms a mound, and not a crater, and is extremely luminous. The physiological effects of the arc are striking. The paper is illustrated with a large number of photographs. J. H. A.

5180. Arc Discharge in Water. Part II. H. D. Carter and A. N. Campbell. *Faraday Soc., Trans.* 27. *pp.* 634–644, *Aug.,* 1932.—A constant-flow calorimeter is described for rapid measurements of the heat evolved by the l.t. arc discharge with carbon electrodes, operating in water; results with this device indicate that the reactions taking place may be slightly endothermic, but a large part of the input energy is expended in heating the water. Definite relationships between the discharge current and chemical reactions have been found, but above a certain critical potential the voltage does not affect the discharge; with a constant current the input wattage has no effect. The chemical reactions which were discussed in the earlier paper are shown to take place entirely on the anode, and further indication of hydroxide formation was obtained. The composition of the gases was altered by raising the discharge temperature, in a manner contrary to that predicted by the " thermal " theories; the contradictory evidence regarding the " water gas " equilibrium at high temperatures is noted. The physical effects of the liquid medium are discussed and the mechanism of the chemical reactions reviewed in the light of recent work on electric discharges. [For Part I see Abstract 3890 (1932).] A. D.

5181. Theory of Arc Discharge. H. A. Schwab. *Zeits. f. Physik,* 77. 11–12. *pp.* 823–828, *Sept.* 3, 1932.—The results of various investigators on the spreading of explosions in electric fields, ignition by electric sparks and on the behaviour of enclosed arcs, are discussed in their bearing on the theory previously advanced [see Abstract 3884 (1932)]. A. W.

5182. Electron Tubes. A. Dauvillier. *J. de Physique et le Radium,* 3. *pp.* 229–238, *June,* 1932.—A technical description of various electron tubes devised by the author for certain special purposes of research, such as obtaining diffraction patterns of electrons diffracted by organic substances, microradiography, X-ray spectra of gases and the study of X-rays of long wave-length in air. The various difficulties to be overcome are described in detail, and examples are given of results obtained by the various kinds of apparatus. A method of microradiography is described which is applicable to very thin sections and which yields instantaneous images if penetrating electrons are used. A detailed account is given of a new type of Lenard tube. H. L. B.

5183. Experimental Studies of Vacuum Tubes at Extremely High Voltages. A. Tuve. *Congrès International d'Électricité, Paris, Sect.* 1. *Rapport No.* 26. [15 *pp.*], 1932.—For the experimental study of the atomic nucleus very high speed electrons and protons and the hardest X-rays are required. The author describes the equipment whereby these are obtainable. Peak voltages of the order of 2 million volts are generated by a Tesla coil and are applied to tubes of series type based on the principle of the Coolidge tube. The results are outlined of the first measurements made with this equipment. W. S. S.

5184. Braun Tube at Very High Frequencies. H. E. Hollmann. *Hochfrequenztechn. u. Elektroakustik,* 40. *pp.* 97–103, *Sept.,* 1932.—For the case where the period of the potential applied to the deflecting plates of a Braun tube is of the order of magnitude of the time taken for the electrons to pass through the space between the plates, a discussion is given of the motion of the electrons in the periodically varying accelerating field. With constant velocity of the kathode rays the dynamic sensitivity of a given tube is found to pass through a series of maxima of decreasing value as the frequency is increased, the maxima being separated by regions of very low sensitivity which can be displaced by variation of the anode potential. The optimum length of the deflecting plates (*i.e.*, the length giving maximum sensitivity) is found to be $(v/c)\lambda/2$, where v is the ray velocity, c the velocity of light and λ the wave-length of the applied potential. Experimental results confirmed the theoretical conclusions. In particular, measurement of the deflecting potential with a 70 cm. wave by a peak voltmeter gave the theoretical ratio of the static to the dynamic sensitivity. Phase displacements were found to occur with the ordinary arrangement of the pairs of deflecting plates. These can be avoided either by phase compensation or by the simple device of dividing one pair of plates into two halves and locating these symmetrically with respect to the other pair of plates. Such an arrangement produces no phase shift, the action of one half neutralising that of the other. An illustration is given of a tube modified in this way and made in the v. Ardenne laboratory. A. W.

5185. Corona Current and Superimposed High Frequencies. A. Gemant. *Zeits. f. Physik,* 78. 3–4. *pp.* 240–249, *Sept.* 21, 1932.—Studies the changes occurring in the " corona " discharge within a very short interval after a change of potential. The main result is that the superimposition of a h.f. discharge upon a d.c. corona discharge raises the current strength of the latter. By means of experiments with a Braun tube, the author shows that the dynamical characteristic first rises and then falls with decreasing time of action. E. E. F. d'A.

5186. Geissler Discharge in Argon. Re-Analysis of Collector Characteristics. K. G. Emeléus and R. H. Sloane. *Phil. Mag.* 14. *pp.* 355–366, *Sept.*, 1932.—Recent investigations of the glow discharge in helium made by a combination of probe and optical methods have shown that it is necessary to review several points of the work of Eméleus and Harris and of Emelêus and Brown. Analyses previously given for a cold kathode glow discharge in argon are reconsidered in the light of more recent knowledge of the properties of cold exploring electrodes. It is shown that although the information obtained in this way for the boundary region between the kathode dark space and the negative glow is not reliable, it is still possible to calculate the electron concentrations there by an application of Boltzmann's theorem. Some effects of secondary emission from the exploring electrode are discussed. A detailed account of the work on helium discharges will be published shortly. [See also Abstracts 2970 (1927) and 1628 (1929).] A. W.

5187. Electrical Discharges in Gases at Low Pressures. I. Langmuir. *Frank. Inst.*, *J.* 214. *pp.* 275–298, *Sept.*, 1932. *Congrès International d'Électricité*, *Paris*, *Sect.* 1. *Rapport No.* 7. [25 *pp.*], 1932.—Fields produced by positive ions and electrons in gases at low pressures are discussed in detail in their bearing on self-supporting and externally maintained discharges. The author deals fully with the type of field called plasma where there is a maximum potential but practically no field, and contrasts it with the type of intense field which covers the electrodes and the walls of the discharge tube. A theory of the positive column is also given. H. L. B.

5188. Prevention of Electrical Discharge in Nitrogen up to 70 kV. H. Fricke. *Zeits. f. Physik*, 78. 1–2. *pp.* 59–70, *Sept.* 8, 1932.—The effect of varying (1) gas pressure, (2) distance between two plane parallel electrodes, on the prevention of discharge through nitrogen is investigated. Different types of discharge tubes and of screening of the electrodes, are described. At 70 kV and 0·02 mm. pressure, with electrodes of diameter 35 mm., the discharge distance was 1·37 mm. for a spherical discharge tube. Accurate investigations in regions of potential greater than 70 kV are likely to prove very difficult. F. C. C.

5189. Discharge Mechanism in Geiger–Müller Electron Counters and its Connection with the Properties of the Normal Glow Discharge. W. Schulze. *Zeits. f. Physik*, 78. 1–2. *pp.* 92–110, *Sept.* 8, 1932.—Describes experiments which show that under certain conditions the discharge through a Geiger–Müller electron counter lasts a very short time, the shape and material of the electrodes and the condition of the electrode surfaces being apparently without effect. The nature of the gas in the tube is of importance, the discharge being discontinuous in such gases as air, hydrogen or oxygen, but continuous in pure helium or neon or a mixture of both. The conditions under which a discharge is immediately extinguished are studied in further experiments with plane parallel electrodes. G. G. S.

5190. Law of Similarity for Gas Discharges and its Range of Validity. M. Steenbeck. *Wiss. Veröff. a. d. Siemens-Konzern,* 11. 2. *pp.* 36–51, 1932.—Following a brief historical review, a comprehensive study is made of the law of similarity for gas discharges under various conditions. The effects are considered of the motion of ions in the electric field, ionisation by impact, diffusion of electrons and ions, recombination of positive ions with electrons and negative ions, attachment of electrons to neutral gas molecules, adsorption of ions and electrons by the discharge tube walls, the magnetic field of the discharge current, excess temperatures in the discharge space, ionisation by successive steps, etc. It is shown that so long as appreciable temperature-differences in the discharge chamber do not occur, most of the above effects may occur without affecting the validity of the law of similarity. The single exception is ionisation by successive steps, especially in the case of non-metastable states. Ionisation by auxiliary gases or at the tube walls by metastable atoms may occur. Under certain conditions, which are fulfilled in vacuum arcs in the rare gases, considerable temperature differences may exist in similar discharges without affecting the law of similarity. In these cases, besides the linear dimensions and gas density, the temperature distributions in the discharges are similar. The law of similarity applied to these cases leads to conclusions arrived at by quite different reasoning from Schottky's theory of the positive column. Chemical reactions in the gas filling the discharge tube have also no influence on the validity of the law of similarity so long as no change of the number of molecules takes place and when excess temperatures are avoided. A. W.

5191. Discharge Delay in Homogeneous Electric Fields in Air at Atmospheric Pressure. R. Strigel. *Wiss. Veröff. a. d. Siemens-Konzern,* 11. 2. *pp.* 52–74, 1932.—An investigation was made of the discharge delay in homogeneous electric fields in air at atmospheric pressure, using a sphere spark gap. The spheres were 5 cm. dia., the gap 0·11 cm. and the static breakdown voltage 5 kV. A kathode-ray oscillograph was used to obtain photographic records of the effects observed. It is shown that the discharge delay at the spark gap in the case of variable rectangular potential rises is determined by the amount by which the applied potential exceeds the static breakdown voltage. For regular and gradual potential rises the values of the delay times fluctuate about a mean value which is dependent on the steepness of the potential rise. A graphical method is given by which the mean value of the delay time may be determined for any given steepness of the potential wave-front. From measurements of the dark pre-discharge current made by means of an electrometer it was found that for an excess potential of 180 % of the static breakdown voltage, every electron leaving the negative electrode led to flashover. Investigation of the effect of the surface conditions of the electrodes showed that layers of grease, gas layers of electronegative gases, as well as oxide or sulphide coatings, increase the duration of the discharge delay by about one order of magnitude or more. The effect of humidity was not fully investigated but it was found that the discharge delay at oxidised copper electrodes is reduced to about half by increase of the humidity from 65 % to 85 %. A. W.

5192. Gas Discharge and Electric Breakdown. W. Rogowski. *Arch. f. Elektrot.* 26. *pp.* 643–678, *Sept.* 3, 1932.—The differential equations for the effect of ionisation and space charge are combined with the equilibrium condition, integrated and applied to the stationary gas (glow) discharge and to the breakdown discharge. An idealised ionisation coefficient α is assumed for the electrons, connected with the field strength E by the relation $\alpha = c_1 e^{-c_2/E}$, where c_1 and c_2 are constants. The solution obtained gives an explanation of the fields at kathode and anode and in the positive column. The kathode and anode falls of potential are explained in a new way. The value of the current density as a function of electrode distance and potential is calculated. The properties of the obstructed glow discharge are deduced and the dependence of the breakdown voltage on radiation and pre-ionisation is determined. New light is thrown on the magnitude of the current density immediately before breakdown and on the associated variations of field. The theoretical results obtained are then compared with actual experimental results, the agreement being in general good. A. W.

5193. Breakdown Investigations in Compressed Gases and in Liquid CO_2. O. Zeler. *Ann. d. Physik*, 14. 4. *pp.* 415–447, *Aug.* 1, 1932.—Measurements were made of the breakdown voltage in air, N_2 and CO_2 at pressures from 1 to 120 kg./cm.^{2}. The most accurate measurements were made with sphere electrodes of 15 mm. dia. With these electrodes Paschen's law, $U = f(p . s)$, was found valid for air up to 50, for N_2 to 30 and for CO_2 to its saturation pressure of 58·5 kg./cm.^{2}. Above these pressures and up to 120 kg./cm.^{2} the increase of the breakdown voltage in air and in N_2 was found less than the pressure increase. The departures from Paschen's law were observed at lower pressures the larger the electrodes. In the case of air and CO_2 they were appreciably less than for N_2. A polarity effect was found with electrodes of different sizes. All the departures from Paschen's law found in compressed gases can be explained by the assumption of positive space-charge effects. Measurements in liquid CO_2 gave the same breakdown voltage as for gaseous CO_2 at the same (saturation) pressure. In liquid CO_2 measurements were made at pressures up to 120 kg./cm.^{2}. The character of the dependence of the breakdown voltage on the pressure was found to be the same as for air in the same pressure region, the breakdown voltage increasing less than proportionally with the pressure. A. W.

5194. Cracks upon the Surface of Dielectrics, Produced by Gliding Spark. T. Terada, M. Hirata and R. Yamamoto. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, Nos.* 380–382. *pp.* 49–66, *Sept.*, 1932. *In English.*—A disruptive spark fed by a large capacity is made to glide along the surface of solid dielectrics such as glass, quartz and so forth. Cracks are produced on the surface and are examined with a microscope. Graphs are drawn between area of crack zone, intensity of spark, size of gap and resistance. When a glass surface is strained by bending, stretching and local heating, the hair-cracks are always parallel to the tension. When the tension exceeds a certain value, the hair-cracks appear suddenly and show a maximum effect. H. M. B.

5195. Physical Phenomena of Electrical Gas Purification. Part III. R. Ladenburg. *Ann. d. Physik*, 14. 5. *pp.* 510–520, *Aug.* 15, 1932.—Discussion of the phenomena of electrical gas purification in cylindrical filters shows that suspended particles of dimensions above 10^{-4} cm. maintain, by their charge and the action of the electric field of the radial corona discharge, their size proportional to their velocity and serve to explain the effectiveness of the filter. Particles of dimensions below 10^{-4} cm. have velocities of only 1·4 to 3 cm./sec. and play only a subordinate part. The electric wind from the point of the emitting electrode to the collecting electrode imparts, under the conditions obtaining in the electro-filter, additional velocities of 20 to 60 cm./sec. to the gas and to the particles suspended in it, but this is reduced by axial streaming of the gas. The exponential formula given by Deutsch for the degree of purification of an electro-filter allows an estimate to be made of the radial velocity of the suspended particles from measurements with a filter of given length and radius and with a given axial gas velocity. [For Part II see Abstract 599 (1931).] A. W.

5196. Minimum Current in the Normal Kathode Fall and in the Positive Column. A. Güntherschulze and H. Schnitger. *Zeits. f. Physik*, 77. 5–6. *pp*. 333–345, *Aug*. 2, 1932.—Rogowski [see Abstract 564 (1932)], has predicted that there should be a minimum value for the current which will support a normal visible discharge and this is investigated. The minimum current is found to be independent of the applied potential and increases with diminishing distance between the electrodes at low pressures. For O_2 and the inert gases it is independent of the pressure but it varies with the pressure in the case of N_2. For H_2, the relation $i^2 = p/5$ holds (i in mA, p in mm. of Hg). The discharge becomes luminous, in the case of O_2 and the inert gases, when the diameter of the luminous region is smaller than three times the thickness of the kathode dark space. At medium pressures this is also true of H_2O and N_2. So long as the discharge current is much larger than the minimum so is the main part of the discharge tube non-luminous when filled with H_2, N_2 and O_2. As the minimum current is approached so striæ move out from the anode and the discharge potential increases. The current flow for these gases is contained in a cone of 10° angle with its apex at the kathode. For the inert gases the angle of the cone may reach 90°. J. E. R. C.

5197. Origin of the Field in the Positive Column. F. Ollendorff and R. Seeliger. *Phys. Zeits.* 33. *pp*. 577–578, *Aug*. 1, 1932.—A brief discussion is given of the characteristics of the positive column and particularly of its uniform potential gradient. A theoretical treatment is then given of the problem of the origin of the field in the positive column by consideration of a simple model consisting of a cylindrical tube with plane electrodes at such a distance apart that the portions of the discharge near the kathode and anode can be neglected in comparison with the length of the positive column. For this model the conditions of surface charge on the cylinder walls are determined for constant potential gradient in the positive column and the results are discussed in relation to various theories which have been advanced to explain positive column phenomena. A. W.

5198. Insulated Potential Probe in Homogeneous Field. H. Jenss. *Arch. f. Elektrot.* 26. *pp*. 557–561, *Aug*. 3, 1932.—A mathematical calculation is made of the potential assumed by an insulated wire or spherical probe in the neighbourhood of a plate electrode which is the origin of a homogeneous field. It is found that the wire acquires the potential of the pole in the dipolar coordinate system formed by the wire and the surface of the plate, while the potential of the sphere is that of a point lying nearer the centre of the sphere than the pole. At great distances from the plate electrode both types of probe have the potential of their mid-points. The magnitude of the correction to be applied to the mid-point potential is calculated and it is found that with spherical probes, even at small distances from the plate electrode, the correction is so small that it can in general be neglected. The results are applicable to any electrode arrangement so long as the dimensions of the probe are small enough for the field to be considered homogeneous. A. W.

5199. Energy Distribution among the Positive Ions at the Kathode of the Glow Discharge through Gases. R. M. Chaudrhi and M. L. Oliphant. *Roy. Soc., Proc.* 137. *pp.* 662–676, *Sept.* 1, 1932.—A study is made of the energy distribution among the positive ions striking the kathode during glow discharges through gases. The retarding potential method and an electrostatic focussing method are employed. Within the accuracy of the experiment the results indicate the distribution to be independent of the current and the voltage across the dark space and to be dependent only upon the pressure. It is found that the maximum energy of the positive ions is equal to the kathode fall of potential, and that at constant pressure the number of positive ions with any specified energy increases proportionally with the current density in the discharge. The results are discussed in detail and a partial explanation of the distribution is suggested. A. H.

5200. Normal Gradient of Gases and Supraconductivity in Rare Gases. A. Güntherschulze and F. Keller. *Zeits. f. Physik*, 77. 11–12. *pp.* 703–712, *Sept.* 3, 1932.—A glow discharge with a positive column 18 cm. long is produced in a spherical glass bulb of 40 cm. diameter. A Mg kathode is situated at the centre and the whole of the inner surface of the bulb, previously " flashed " with Mg, forms the anode; disturbing effects due to the proximity of the walls are thus eliminated. For A up to about 46·3 mm. and for Ne up to about 28·8 mm. pressure of Hg, respectively, no fall in potential along the positive column is found. These gases thus exhibit a kind of supraconductivity. In He a small gradient is found but this may be due to the presence of impurities. In H_2 a normal gradient of 2·40 volts/cm./mm. is found, in good agreement with previous measurements. The results are examined in relation to the work of Ramsauer on the effective cross-section of the rare gases. F. C. C.

5201. Acceleration of "Thread Rays." E. Brüche. *Zeits. f. Physik*, 78. 1–2. *pp.* 26–42, *Sept.* 8, 1932.—The " thread ray " is a limiting case of the " knot ray," in which each electron oscillates between the sides of the envelope along its path. The generation of a thread ray depends upon the kind and pressure of the gas, the current intensity and the build of the accelerating arrangement. The form, position and aperture of the anode diaphragm all contribute in determining the truth of the thread. The accelerating system is regarded as quasi-optical, and the analogy is traced by means of a Braun tube. E. E. F. d'A.

5202. Study of Kathode Rays outside the Generating Tube. W. D. Coolidge and C. N. Moore. *Congrès International d'Électricité, Paris, Sect.* 1. *Rapport No.* 19. [18 *pp.*], 1932. *Gen. El. Rev.* 35. *pp.* 413–417, *Aug.*, 1932.—After tracing the historical development of kathode-ray tubes, a brief description is given of a modern type suitable for use with an applied voltage of 300,000 volts, also of multiple tubes in which the total applied potential is distributed between a series of pairs of tubular electrodes, the electrons emitted by the kathode thus being successively accelerated. For obtaining kathode rays external to the generating tubes, windows are provided of aluminium or some light alloy. By taking suitable precautions the thickness of such windows may be reduced to about 1/80 mm. A part of the kathode beam is dispersed during passage through the window, but a considerable part emerges into the air through the window and may be employed to ionise gas, to produce luminescence and scintillations, to produce changes of colour in certain materials and also to generate X-rays. A description is given of such effects and of other chemical and biological effects produced by the external kathode rays. A. W.

5203. Optical Investigation of the Reflection of Hydrogen Canal Rays by Solid Bodies. E. Horovitz. *Phys. Zeits.* 33. *pp.* 579–582, *Aug.* 1, 1932.—A spectrographic method of investigation is described, in which the primary beam of canal rays is perpendicular to the line of vision. The results show that the canal rays are reflected from a glass surface not in a single direction, but in directions enclosed by a solid cone. Since for large angles of incidence the maximum displacement of the Doppler lines is greater than for small angles, it appears that rays of greater speeds are reflected at glancing than at normal incidence. H. F. G.

5204. Polarisation of Light from Moving and Stationary Particles of Hydrogen Canal Rays. (Miss) W. A. Lub. *K. Akad. Amsterdam, Proc.* 35. 6. *pp.* 826–837, 1932.—Two sets of spectrograms are described in which the axis of the spectrograph made angles of 64° and 74° respectively with the direction of propagation of the canal rays. In both sets the polarisation is measured for H_β, H_γ and H_δ, for the stationary and displaced components in each case. It is found that the polarisation of the light of canal rays is due chiefly to the moving particles, although the stationary particles contribute a little. It is also observed that the polarisation decreases as the serial number of the line increases. A. H.

5205. Positive Rays and the Determination of Isotopes. E. N. da C. Andrade. *Congrès International d'Électricité, Paris, Sect.* 1, *Rapport No* 20. [24 *pp.*], 1932.—Gives an account of the mass-spectrograph, and its application to the determination of the isotopes of the chemical elements. H. N. A.

5206. Slow Ionic Rays of Mercury. F. Beyerlein. *Zeits. f. Physik*, 77. 9–10. *pp.* 632–643, *Aug.* 24, 1932.—The positive beams or rays of ions produced by the streaming of mercury vapour through nozzles of glass or iron were investigated. The specific charge yields chiefly ions of Hg and Hg_2. At low pressure and small ray density the beam consists uniformly of Hg_2^{++} ions. With higher ray density other ions appear along with a ray which is not magnetically deflected. With the setting-up of the ionic beam the nozzle becomes negatively charged. J. J. S.

5207. Excitation of Atomic Rays by H.F. Discharges. A. Bogros and F. Esclangon. *Comptes Rendus*, 195. *pp.* 368–370, *Aug.* 1, 1932.—H.F. electromagnetic oscillations make it possible to produce in gases and vapours the emission of suitable rays of sufficient brilliancy for the study of hyperfine structure. In the case of light or not readily volatile elements the Doppler effect causes a considerable widening of the spectral lines; moreover, the method cannot be applied to substances which are very active chemically, such as lithium, which attacks all transparent bodies at the temperatures at which it is capable of being excited. By using atomic rays the authors succeed in considerably diminishing the Doppler effect in a direction of observation normal to the rays, and, moreover, can produce rays of narrow wave-length from refractory metals, or such as are very active chemically. In this way it has been possible to observe luminous beams of sodium, lithium and cadmium. By introducing a foreign gas, such as argon or nitrogen, at a pressure of about 0·002 mm. of Hg the intensity is enhanced. The complete arc spectrum of the metal appears. It is believed that the method will be particularly useful for studying hyperfine structure of spectral lines. H. L. B.

5208. Ions in Gases. M. Laporte. *Congrès International d'Électricité, Paris, Sect.* 1. *Rapport No.* 8. [16 *pp.*], 1932.—The following subjects are discussed. Formation, nature and properties of ions in gases; attachment of electrons; complexes of negative ions; production of positive ions; complexes of positive ions; probability of ionisation and methods of ionisation. H. L. B.

5209. Value of Townsend Coefficient for Ionisation by Collision at Large Plate Distances and near Atmospheric Pressure. F. H. Sanders. *Phys. Rev.* 41. *pp.* 667–677, *Sept.* 1, 1932.—The Townsend coefficient of ionisation by collision was measured at a pressure of 380 mm. in air at plate distances ranging from 1 to 5 cm. and for values of X/p (the ratio of the field strength to the pressure in mm.) from 20 to 36·5. Townsend's relation was found to be valid under these conditions. The results show that ionisation by collision exists at much lower values of X/p than those given by Paavola. The rise in the saturation photoelectric current at the lowest X/p compares in order of magnitude with results found by extrapolation from Bradbury's equations [see Abstract 3893 (1932)]. This indicates that below $X/p = 20$ measurements of α are of doubtful value. No abnormal increase in the current with plate distance was found even within 2 % of sparking. This shows that if ionisation by positive ions does exist it must occur at field strengths less than 2 % from the sparking values. A. W.

5210. Experiments on Potassium Ions in Potassium Vapour. H. J. J. Braddick. *Phil. Mag.* 14. *pp.* 450–464, *Sept.*, 1932.—The attachment of a relatively fast-moving K-ion to a K-vapour atom, as found by Ditchburn and Arnot [see Abstract 2803 (1929)], does not take place sufficiently frequently to afford an explanation of their results. When emission occurs from an adsorbed film of metallic K, some molecular ions are formed. These may be produced either by the direct evaporation of molecular ions from the film or by attachment, as above, occurring near the surface. Both these explanations introduce theoretical difficulties, and further work, concerned more especially with the variation of the emission of K_2^+ with temperature and with the state of the surface, is necessary before a satisfactory theory can be developed. J. S. G. T.

5211. Surface Ionisation of Potassium by Tungsten. P. B. Moon and M. L. E. Oliphant. *Roy. Soc., Proc.* 137. *pp.* 463–480, *Aug.* 2, 1932.—A method is described by which the ionisation of K vapour by a hot metal surface is used to produce a steady and intense beam of K^+ ions. The beam so obtained is allowed to fall on a tungsten target which can be heated. Re-emission of the K^+ ions from this target under various conditions was investigated in order to study the mechanism of surface ionisation. Langmuir and Kingdon [see Abstract 1182 (1925)] have predicted that a surface whose electron work function is greater than the first ionisation potential of the vapour will ionise each vapour atom which collides with it. Moon [see Abstract 1352 (1932)] has found, in support of this, that no net current flows to a sufficiently hot surface when bombarded with slow Cs^+ ions, but that there was a drop in ionising efficiency when the bombarding ions were fast. These observations are confirmed and extended by studying the building-up and evaporation of surface layers deposited as slow and fast ions. The rate of evaporation of K^+ ions originally deposited as slow ions is a linear function of the surface concentration of K^+. The rate of evaporation per unit concentration varies with the absolute temperature as $e^{-\phi/KT}$, where ϕ is about 4·4 electron volts and is identified with the K^+ ion work function. The evaporation of K as K^+ ions depends upon the speed of the ions, the target temperature and the length of time for which the K has been deposited. The re-emission of the K^+ ions is by thermal evaporation, and not by reflection.

J. E. R. C.

5212. Electron Ionisation of Nitrogen, Oxygen and Air at Low and High Pressures. K. Masch. *Arch. f. Elektrot.* 26. *pp.* 587–596, *Aug.* 3, 1932.—A simple method for determining the ionising coefficient α is based on observations of the dark pre-discharge current. The saturation current i_0 is found by photoelectric measurements. For a constant and homogeneous field Townsend has given the relation $i = i_0e^{\alpha x}$ for the dependence of the dark pre-discharge current i on the distance x from the kathode. If d is the distance between the electrodes $i = i_0e^{\alpha d}$, and this relation was used for experimental determinations of α. Measurements were made in N_2, O_2 and air with small and with large field strengths. The results are tabulated and also given in graphical form. In the case of air the results are in agreement with those of Paavola. For N_2 the values of α for high values of the ratio of field strength to pressure agree with Townsend's results. At low field strengths discrepancies are found. Discussion shows that the present results are probably correct. In the case of O_2, on account of its higher electron affinity, it would be anticipated that α would be less than for N_2. On the other hand O_2 has a lower ionisation potential than N_2. The results obtained show that for low field strengths the effect of electron affinity predominates, while for higher field strengths the effect of the low ionisation potential is the more important. The results also confirm the law of similarity. A. W.

5213. Ionisation Potential of Helium. A. Plümer. *Zeits. f. Physik*, 77. 5–6. *pp.* 356–363, *Aug.* 2, 1932.—The errors in the determination of the critical potentials of helium are discussed. The influence of the gas pressure, the field, impurities and photoelectric effects are investigated, and an apparatus is used in which errors due to these causes are believed to have been eliminated. The final results are: a resonance potential at 19·3 ± 0·2 volts; and the first and second ionisation potentials at 24·4 ± 0·2 volts and 79·0 ± 0·5 volts. A comparison table of the results of other authors is included. J. E. R. C.

5214. Ionisation of Neon and Argon by Positive Alkali Ions of Energies from 650 to 2000 Volts. J. C. Mouzon. *Phys. Rev.* 41. *pp.* 605–612, *Sept.* 1, 1932.—With an apparatus of new design the study of the ionisation of neon and argon by positive alkali ions has been extended to accelerating potentials as high as 2000 volts. The results obtained are in good quantitative agreement with the previous work at the low potentials. In a number of cases the efficiency of ionisation reaches a maximum at accelerating potentials less than 2000 volts. AUTHOR.

5215. Dissociation due to Impact of Positive Ions. A. C. G. Mitchell. *Zeits. f. Physik*, 78. 1–2. *pp*. 138–140, *Sept*. 8, 1932.—A reply to Schechter's criticism [see Abstract 3411 (1932] of the author's results, which are considered to be correct, and which are to a certain extent confirmed by recent work of Kunsman and Nelson. A. W.

5216. Recombination of Hydrogen Atoms on Metallic and Oxidised Nickel. L. S. Ornstein and A. A. Kruithof. *Zeits. f. Physik*, 77. 5–6. *pp*. 287–289, *Aug*. 2, 1932.—The mean free path of electrons in a discharge tube containing a nickel Faraday box [see Abstract 3439 (1931)] is much smaller when the Ni is bright than when it is superficially oxidised. This is due to the fact that the surface oxidation reduces the recombination of H atoms on the Ni. The dependence of the cross-section of H_2 on the electronic velocity is found to be in agreement with earlier measurements. J. E. K.

5217. Motion of Electrons. M. Didlaukis. *Zeits. f. Physik*, 77. 5–6. *pp*. 352–355, *Aug*. 2, 1932.—A simple method for the exact calculation of the motion of electrons under very general conditions. Special cases are discussed, and the results compared with the results of experiment. J. E. R. C.

5218. Motion of Electrons in the Field of Excited Helium. J. McDougall. *Cambridge Phil. Soc., Proc*. 28. *pp*. 341–348, *July* 30, 1932. —In the problem of scattering of electrons by atoms with change of state of the atom (inelastic collisions) the asymptotic solutions of the wave equation corresponding to the receding scattered electrons must fit solutions of the wave equation appropriate to the *excited* atom. The necessary phase constants in the asymptotic solutions are here evaluated for the use of electrons which are scattered from helium atoms which have been excited to the 2*p* state in the scattering process. Similar calculations have already been made for the case of elastic collisions [see Abstract 4114 (1932)]. The present results are required for the calculation of inelastic collision probabilities. W. S. S.

5219. Electron Motion in a Crystal Lattice. G. C. Wick. *Accad. Lincei, Atti*, 16. *pp*. 142–149, *Aug*., 1932.—Shows how, taking account of the resonance forces due to the identity between a conducting electron and the electrons bonded to the lattice, the energy levels of an electron in a lattice may be calculated out to a first approximation. There is found a relative maximum of energy for a null velocity of the electron. A. D.

5220. Electronic Collision on Crystal Surfaces as a Proof of Optical Energy Levels. R. Hilsch. *Zeits. f. Physik*, 77. 7–8. *pp*. 427–436, *Aug*. 6, 1932.—From measurements against the field in a suitable apparatus, the corrected electron velocities are obtained. For NaCl, KCl, KI, LiF, NaF and CaF_2 the first drop in electron reflection corresponds to the optical transmission limits. The electron reflection is only elastic in the region of low velocities: when the optical transmission limits are reached, inelastic reflection sets in. F. I. G. R.

5221. Diffraction of Kathode Rays by Single Crystals. Part II. Mean Inner Potentials of Crystals. K. Shinohara. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 375. *pp.* 315–322, *Aug.*, 1932.—When a beam of kathode rays is directed against a cleavage face of a crystal at a grazing angle, the cleavage plane gives several Kikuchi lines showing successive orders of reflection. From the measurement of these lines the mean inner potentials of crystals may be determined. The method is described in Part I of this paper [see Abstract 4549 (1932)]. The values of the mean inner potentials obtained for calcite, rock-salt and mica are found to be $10 \cdot 5$, $6 \cdot 3$ and $10 \cdot 4$ volts respectively. The value for rock-salt agrees well with that calculated by Havighurst from the intensity of X-ray reflection. It is shown that as a result of the effect of the refractive index differing from unity, a black or a white line appears obliquely to the line of intersection of the cleavage face with the photographic plate; such a line shows a slight curvature from which the mean inner potential of the crystal can roughly be obtained. H. L. B.

5222. Transmission of Electrons by Thin Gold Films. Mildred Allen. *Frank. Inst., J.* 214. *pp.* 43–73, *July*, 1932.—Results are given of the change in velocity of electrons transmitted through thin gold films and the dependence (for small angles) of the number transmitted on the angle between the initial and final directions of the beam. The method used for analysing the velocity distribution of the beam of electrons was that of applying a magnetic field perpendicular to the direction of motion of the electrons. In a film thickness of $1 \cdot 5 \times 10^{-5}$ cm. the Thomson-Whiddington law for the average value of the velocity of the transmitted electron is found to hold. The velocity distribution is much wider than that of the incident beam. In the case of gold films 6×10^{-6} cm. thick the shift in the most probable velocity of the transmitted electrons is very small, and at the higher velocities practically non-existent. The evidence obtained suggests that the constant of the Thomson-Whiddington law is a function of the velocity of the incident electrons, increasing with an increase in their velocity. H. L. B.

5223. New Photoelectric Phenomenon. Q. Majorana. *Comptes Rendus*, 195. *pp.* 226–228, *July* 18, 1932. *Accad. Lincei, Atti*, 16. *pp.* 82–86, *Aug.*, 1932.—Pellets of Au, Ag, Pt, Sn, Al and Zn are attached to glass and illuminated with a strong light interrupted at frequencies of 5–600. The current passes through the pellet and the primary of a transformer, the secondary of which is connected through a multi-valve amplifier, to a telephone. It is found that the light effects a change of resistance. **Errata,** *ibid.*, p. 472, Aug. 22, 1932. J. E.

5224. Photoionisation of Vapours of Anthracene and Diphenylamine. E. C. Allberry. *Phil. Mag.* 14. *pp.* 400–404, *Sept.*, 1932.—The currents obtained by Stark [see Abstract 1917 (1909)] on illuminating the vapours, are shown not to be due to direct photoionisation of the vapour. G. C. McV.

5225. Response of Gasfilled Photoelectric Cells to Sudden Illumination. P. Fourmarier. *Comptes Rendus*, 195. *pp.* 378–380, *Aug.* 1, 1932.—When cells were exposed to sudden illumination, the current from the cell varied with time, being made up of two components, one of which is established instantaneously, and another which grows up more slowly. Similar effects are observed when the illumination is withdrawn.

The effects appear to be independent of the nature of the kathode. The instantaneous component is regarded as due to ionisation by primary electrons, and the second component as caused by ionisation by positive ions or by the separation of secondary electrons from the kathode.

G. E. A.

5226. Time-Lag in Photoelectric Cells and the Townsend Discharge. N. R. Campbell. *Phil. Mag.* 14. *pp.* 465–486, *Sept.*, 1932.—The paper continues the work of Campbell and Stoodley [see Abstract 616 (1931)]. Two methods of experiment are used, firstly that of taking frequency response curves for light of frequency controlled by a rotating disc with apertures in it, and secondly that of studying the effect on the photoelectric cell, of single flashes of light. It is probable that more than one type of lag exists, and neither is primarily due to charges on the glass walls of the cell. Such charges were detected, but their rôle is not that of producing the time-lag. One form of time-lag (called the l.f. lag by the author, because chiefly effective at low frequencies) could be well studied by the single-flash method, using a pendulum to excite the flash and to disconnect an electrometer at a known time after its occurrence. Other forms which may exist require a closer analysis than is provided by such a method. The l.f. lag is especially associated with " thin-film " kathodes of low work-function, and is therefore connected definitely with the kathode; probably with secondary emission from it, arising in some way out of ionisation of the gas. In this lag the usual fall in the frequency-response curve with increasing applied voltage and magnification is not due to a change in the relative proportions of the two parts of the current (one part independent of frequency, the other part varying with it); it is therefore due to a true change in the lag. The l.f. lag increases at low temperature, and probably arises in some thermal motion. It is emphasised that the part of the current which is stated to be independent of frequency when frequency-response curves are studied is actually constant, at least to 3 parts in 1000, over the frequency range 5 to 8000 interruptions per second.

J. H. A.

5227. Independent Photoelectric Potential. H. Teichmann. *Zeits. f. Physik*, 78. 1–2. *pp.* 21–25, *Sept.* 8, 1932.—Endeavours to reduce all the cases of photoelectric action to one point of view. Concerning the essential interaction between the atom and the light quantum we know nothing beyond Einstein's energy relation. But the general law may be expressed as follows: the occurrence of an independent photoelectric potential is conditioned by the presence of a threshold of potential brought about by the contact of media in which the distribution of permitted electronic conditions differs.

E. E. F. d'A.

5228. Photoelectric Effect of L_{II} and L_{III} Electrons for γ-Rays. T. Muto. *Inst. Phys. and Chem. Research, Sci. Papers, No.* 372. *pp.* 249–298, *July*, 1932. *In English.*—Dirac's relativity wave equation for the electron is used, in the form appropriate to motion about a central positive of charge Z subject to the perturbation expressed by the vector potential $A_y = A\cos 2\pi\left(\nu t - \frac{Z}{\lambda_0}\right)$. The photoelectron current density (radial component) is evaluated for transitions of L_{II} and L_{III} electrons respectively, and is obtained as a function of the angle of emission θ. Integrating over the sphere, the total photoelectric emission per sec. is determined, which in turn gives the atomic absorption coefficients. The latter is found to be proportional to Z^7 for both L_{II} and L_{III} electrons. The variation with the frequency of the incident radiation cannot be expressed in a simple form. All the calculations apply only to light elements ($Z/137$ small compared with unity), and comparison with experiment is not yet possible because of the difficulty of measuring the photoelectric emission of light atoms. W. S. S.

5229. Stop-Layer Photoelectric Effect. F. Waibel and W. Schottky. *Phys. Zeits.* 33. *pp.* 583–585, *Aug.* 1, 1932.—Photoelectric cells prepared by deposition of Ag or Au from the vapour phase upon Cu_2O exhibit less than 0·0001 of the spontaneous photoelectric effect observed with cells of the "stop-layer" type, and are entirely free from the so-called internal photoelectric effect. The existence of "stop-layer" photoelectric currents of 100–1000 times the quantum equivalent has been demonstrated. H. F. G.

5230. Emission of Photoelectrons from Zinc Crystals. A. Nitzsche. *Zeits. f. Physik,* 14. 4. *pp.* 463–480, *Aug.* 1, 1932.—Tests the distribution of velocities of photoelectrons emerging from a single crystal of zinc. Finds that the work of emergence is greater in the case of surfaces cut in a direction normal to the hexagonal axis than from surfaces cut parallel to that axis. E. E. F. d'A.

5231. Theory of Photoelectric Emission by Crystals. H. T. Wolff. *Phys. Zeits.* 33. *pp.* 621–624, *Aug.* 15, 1932.—Calculations based upon wave mechanics are made to explain the photoelectric emission by crystal surfaces discovered by Dember [see Abstract 2993 (1932)]. There are two effects concerned in the emission. Firstly, electrons are preferably emitted in the direction of the light. Secondly, electrons are absorbed and re-emitted on the other side of a plane normal to the beam. In a strongly absorbing substance like cuprite, this effect is much stronger than the first. E. E. F. d'A.

5232. Photoelectric and Thermionic Emission from Composite Surfaces. W. B. Nottingham. *Phys. Rev.* 41. *pp.* 793–812, *Sept.* 15, 1932.—Considers the form of the potential barrier produced by an atom layer of electropositive metal when deposited on an electronegative base. Calculates the shape of the barrier, which turns out to be practically parabolic and about 4×10^{-8} cm. in width. This surface model explains very naturally the fact that the electrons emitted from a composite surface have an apparently Maxwellian distribution of velocities corresponding to a temperature 50 % higher than that of the filament as reported by Koller and Rothe. E. E. F. d'A.

5233. Emission Mechanism of Oxide Kathodes. H. Kniepkamp and C. Nebel. *Wiss. Veröff. a. d. Siemens-Konzern,* 11. 2. *pp.* 75–87, 1932.—An oscillographic method is described for investigating the variation with time of the activity of barium oxide kathodes. Assuming Richardson's straight-line law to hold for very short times the method permits the changes of the characteristic emission constants to be followed. The method was applied to study the phenomena of the de-activation of a prepared kathode due to emission and its re-activation by flashing without emission. The results show that the observed activity variations are probably due to changes of the covering of the emitting surface with oxygen atom dipoles. The electron emission work of the barium oxide kathode investigated was found to be between 0·95 and 1·10 V when the surface was free from oxygen, and about 1·7 V when the emitting surface was fully coated with an oxygen layer. The electrolytic part of the conductivity in the oxide layer is, for small space-charge saturated emission currents, sufficient to cause a complete covering of the active surface with oxygen. The relative proportion of ionic to electric conductivity of the glowing barium oxide appears to rise with the temperature in the temperature range from 1000° to 1200° K. A. W.

5234. Emission by Glasses of the Composition $B_2O_3 + Na_2O$. H. Bölling. *Phys. Zeits.* 33. *pp.* 625–632, *Aug.* 15, 1932.—Results are obtained for the emission of ions by glasses of the composition $B_2O_3+Na_2O$ and are compared with certain results obtained by Murawkin [see Abstract 2678 (1931)], which are subjected to criticism. If the current strength of emission is plotted against time, a curve is obtained which first falls and later becomes approximately horizontal. This shape of the curve results from the superposition of two effects. When the temperature is increased the intensity of emission increases. If the emission has been determined for a certain temperature, and if the temperature is then increased, it is found that on returning to the lower temperature there is a decrease in the emission. The point of emission of all the glasses investigated lies at 160° C. An increase in the sodium content of the glass causes an increase in emission. The paper contains a number of quantitative details for different conditions, such as the presence of moisture. H. L. B.

5235. Influence of Oxygen on the Thermionic Emission of Platinum. H. Cassel and E. Glückauf. *Zeits. f. phys. Chem.* 18. *Abt.B.* 4–5. *pp.* 347–359, *Aug.*, 1932.—Experiments are carried out to find how the emission of electrons from glowing Pt is affected after being in the presence of O_2. After repeated pumping out and heating the tube containing the Pt, the emission voltage remains constant at 8·5 volts for pressures lower than 10^{-5} mm. of Hg. No change is seen after heating in an atmosphere of Hg vapour, but the emission voltage is reduced considerably when H_2 is used. After pumping out the H_2 the limiting value 6·5 volts is reached; this agrees with earlier observations. Results indicate that an irreversible reaction is produced by a thin oxide film on the Pt. H. M. B.

5236. Emission of Incandescent Platinum in Iodine and Chlorine Vapours. E. Müller. *Ann. d. Physik,* 14. 7. *pp.* 831–855, *Sept.*, 1932.—Emission in chlorine falls off rapidly in a few minutes from an initial value of 2×10^{-7} ampere/cm.^{2} at a pressure of 2 mm. Hg. In iodine the initial value is lower. This behaviour may be due to chemical action. E. E. F. d'A.

5237. Propagation of Electromagnetic Waves in Material Media. L. Brillouin. *Congrès International d'Électricité, Paris, Sect.* 1. *Rapport No.* 18. [50 *pp.*], 1932.—A comprehensive theoretical treatment of the subject is given. Expressions are derived for phase-velocity, group velocity and velocity of transport of energy, which are applied in consideration of the signal velocity and of the pulsations, termed precursors, which precede the main signal. These general results are then applied to particular classes of media. The paper does not admit of a brief abstract. A. W.

5238. Production of Circularly Polarised Electrical Waves by Single Total Reflection. L. Bergmann. *Phys. Zeits.* 33. *pp.* 582–583, *Aug.* 1, 1932.—Although circularly polarised waves cannot be obtained by a single reflection of visible light, owing to the relatively low refractive indices obtaining, their production in this manner from h.f. oscillatory waves should theoretically be possible. An apparatus for demonstrating the circular polarisation of waves of 250 cm. wave-length on total reflection at a water-air interface is described. H. F. G.

5239. Electrical Vibrations of Rod-Shaped Conductors. E. Hallén. *Ann. d. Physik,* 14. 5. *pp.* 586–588, *Aug.* 15, 1932.—A note on a paper on this subject by Lindman [see Abstract 3431 (1932)]. Comment is made on the use of approximation formulæ, and on the fact that calculations for an ellipsoid do not accurately apply to a cylinder. **K. F. Lindman** (*ibid.*, 15. 1. *pp.* 127–128, *Oct.* 11, 1932) comments on Hallén's paper and refers to points of agreement between his own measurements and the values calculated by Abraham's theory, and also to cases of agreement and disparity of these results with Hallén's formula. J. J. S.

5240. Ferromagnetism and Related Problems of the Theory of Electrons. P. S. Epstein. *Phys. Rev.* 41. *pp.* 91–109, *July* 1, 1932.—A mathematical study of the electrons which hold together a chemically elementary crystal and are responsible for the homopolar bonds between neighbouring atoms. The theory gives, for nonmagnetic bodies, a confirmation of Bloch's conclusions [see Abstract 2925 (1930)], but the results for magnetic materials are entirely different from Bloch's. The specific heat is expressed by $c = 0{\cdot}208sR(T/\theta)^{3/2}$, where s is the number of valency electrons per atom, R is the gas constant, and θ has a close relation to the Curie point. A crystal satisfying Slater's equations [see Abstract 2726 (1930)] is spontaneously magnetised almost to saturation. This fact suggests that ferromagnetic crystals must have a " block " structure. G. E. A.

5241. Experiments on the Nature of Ferromagnetism. F. Bitter. *Phys. Rev.* 41. *pp.* 507–515, *Aug.* 15, 1932.—Irregularities in the magnetisation of ferromagnetic crystals were studied by means of magnetic Fe_2O_3 particles about 1 μ in diameter suspended in ethyl acetate. On iron crystals the particles settle along parallel lines spaced about 0·1 mm. apart and more or less at right angles to the applied field. On nickel crystals the pattern is similar, but the lines split up into more complicated structures as the applied field is increased. On cobalt crystals straight lines are obtained on some crystals, and spotty patterns on others. The spots arrange themselves in rows when the crystals are magnetised. The patterns can be destroyed by relatively slight surface strains. There is some evidence that in the straight-line patterns the direction of the lines is related to the direction of magnetisation. An explanation of these effects is not known. AUTHOR.

5242. Ferromagnetism and Electrical Characteristics. Part VI. Longitudinal and Transversal Alteration of Ferromagnetic Resistance. E. Englert. *Ann. d. Physik,* 14. 5. *pp.* 589–613, *Aug.* 15, 1932.—The previous work [see Abstract 4598 (1932)] is continued, and includes investigations of the decrease of resistance by certain magnetisation in strong transverse and longitudinal fields, the connection between striction and the transverse saturation resistance decrease of Ni, the alteration of the resistance of Ni due to mechanical forces and the alteration of the orientation of the magnetic vectors, the striction relation to longitudinal saturation resistance alteration of Ni, the longitudinal and transverse alteration of resistance of 92 % Fe and 8 % Ni alloy, hysteresis of resistance, and the temperature effects on saturation magnetisation and alteration of resistance. The decrease in the resistance experienced in high external longitudinal and transverse fields is attributed to the increase of spontaneous magnetisation, and is proportional to the square. The alteration of ferromagnetic resistance is related to the direction of the alteration of the magnetisation vector according to the equation: $\Delta R = aR_0J^2_\infty\,(\overline{\cos^2\vartheta} - \overline{\cos^2\epsilon})$. **W. Gerlach** adds a note in which he shows that the results are in agreement with his previous work, and also with that of Webster. S. G. B.

5243. Recent Researches upon Magnetism (Theoretical). L. Néel. *Congrès International d'Électricité, Paris, Sect.* 1. *Rapport No.* 14. [21 *pp.*], 1932.—The report is in three parts. Part I reviews the results obtained according to spectroscopic theory for pure paramagnetic bodies, *i.e.*, paramagnetic bodies the bearers of the moments of which are not in any other field of force than the external magnetic field. The formulæ for oxygen, oxides of nitrogen and the ions of the rare earth family are verified satisfactorily from the data quoted. Part II treats of the paramagnetism in an internal field, *i.e.*, those forces where coupling forces exist between the moment bearers and the lattice, or between the moment carriers themselves. In the light of the theories so evolved the moments observed in the ions of the iron family and the equation of state for ferromagnetic bodies are discussed. In evidence are taken into consideration certain general properties which any complete theory of ferromagnetism would necessarily have to explain and coordinate, and, in addition, several suggestions relative to variation of moments of the ferromagnetic state from those of the paramagnetic state are examined. The difference between the Curie points and the properties of monocrystals of the cubic system (iron, nickel) are also points under review. In Part III a tentative explanation is given of paramagnetism, independent of the temperature. [See also following Abstract.] S. G. B.

5244. Recent Researches on Magnetism (Experimental). P. Weiss. *Congrès International d'Électricité, Paris, Sect.* 1. *Rapport No.* 15. [34 *pp.*], 1932.—The review is in three parts. Part I critically examines the accumulated data on the thermal variation of paramagnetism, and emphasises the insufficiency of the generally accepted mechanism in this connection to explain the various phenomena. The principle of " uniformity of the carriers of moments " is suggested as being manifested in the initial magnetisation. Part II is devoted to the actual state of the elementary moment. The spectral explanation is more or less satisfactory for gases and rare earths, but it is not valid for the ions of the iron family, where the use of the classic formulæ or the experimental magneton is made. In Part III a review is given of the work of Sadron on the magnetisation to saturation of alloys at low temperatures, and upon this is based a discussion of the generality of ferromagnetic moments in the periodic system of elements. [See also preceding Abstract.] S. G. B.

5245. Electric and Magnetic Units. L. Joly. *Congrès International d'Électricité, Paris, Sect.* 2. *Rapport No.* 1. [17 *pp.*], 1932.—An historical account of the discussions and decisions as to electric and magnetic units. From this it appears that while agreement is complete regarding electrical units, there is divergence of view between engineers and physicists as regards magnetic units, the former for their ordinary purposes making use principally of *induction*, and the latter of *field* as the basis of measurements. J. J. S.

5246. Nomenclature of Magnetic Units. A. Cotton. *Congrès International d'Électricité, Paris, Sect.* **2.** *Comm. No.* 1C**2.** [7 *pp*.], **1932.**—A criticism of the nomenclature proposed for magnetic units by the Stockholm Conference and the Sub-Committee appointed for the purpose. The author emphasises the desirability of maintenance of the term " gauss " as the unit of measurement of the strength of a magnetic field, and furthermore proposes the term " gaussi " as the unit of magnetic induction. He quotes historical argument in support, and gives a comprehensive review of the nomenclature of the various magnetic quantities. S. G. B.

5247. Measurement of Magnetic Fields. A. Cotton and G. Dupouy. *Congrès International d'Électricité, Paris, Sect.* **2.** *Rapport No.* 11.*bis*. [**23** *pp*.], **1932.**—An excellent and comprehensive review of the various methods now available for the experimental measurement of magnetic fields. The paper is in two sections, namely, Part I dealing with direct and Part II with indirect methods of measurement. Part I discusses the various types of electromagnetic balance due to Wills, Sève, Weiss, Piccard, and the various points relevant thereto. In the same section induction methods as distinct from electromagnetic methods are next discussed, such as, *e.g.*, those employing, (*a*) a ballistic galvanometer, (*b*) a fluxmeter, and the Sève method of mutual induction of two coils. The third part of the same section deals with the absolute measurement of a current by the potentiometer, and finally the section concludes with comparisons of the results obtained by the various methods. Part II, in reviewing the indirect methods, includes the fluxmeter, magnetic repulsions, the gaussmeter, utilisation of magneto-crystalline phenomena, the employment of the Zeeman effect and the use of magnetic rotation of polarised light, *i.e.*, the Kerr effect, etc. The review is concise and sets out clearly the essential points of each method enumerated. S. G. B.

5248. Barkhausen Effect. Part III. Nature of Change of Magnetisation in Elementary Domains. R. M. Bozorth and Joy F. Dillinger. *Phys. Rev.* **41.** *pp.* **345–355,** *Aug.* **1, 1932.**—It is found that the small sudden changes in magnetic moment which take place when material is magnetised, have components perpendicular as well as parallel to the direction of the magnetic field. Quantitative measurements of the transverse and longitudinal effects (changes in moment perpendicular and parallel to the direction of the field) show that the longitudinal effect is the larger when the magnetisation is small, and that the transverse effect is larger when the magnetisation is large. Materials examined are (polycrystalline) annealed iron, hard-worked iron and perminvar. The results are interpreted in terms of the domain theory, according to which ferromagnetic materials consist of small regions or domains always magnetised to saturation. Changes in magnetisation are accomplished only by changes in the directions of magnetisation in the domains. Sudden changes from one to another of the natural directions of magnetisation in the crystal give rise to the Barkhausen effect, and in general have definite transverse and longitudinal components, the former now observed for the first time. The experiments show that when the gross magnetisation (that of the substance as a whole) is small, the application of an additional magnetic field causes reversal of the direction of magnetisation in the domains for which this direction was initially nearly antiparallel to the field. Experiments on annealed iron with high gross magnetisation indicate, on the contrary, that the direction of magnetisation in a domain may be altered through 90°. AUTHORS.

5249. Magnetisation Coefficient of Water. P. Sève. *Congrès International d'Électricité, Sect. 2. Rapport No.* 11. [29 *pp.*], 1932.—A review of the work on the determination of the coefficient of magnetisation of water as carried out by a large number of observers. After tracing the historical development of the subject, the experimental methods and results of a number of workers are given. The paper concludes with a statement that the coefficient of magnetisation of water at 20° C. is fixed with an accuracy of 1 in 1000 as being according to Piccard and Devard, $-0\cdot71993 \times 10^{-6}$, and as a round figure $-0\cdot720 \times 10^{-6}$ may be taken. The thermal variation of the coefficient is less accurately known, but it is positive in nature, and very small up to 100° C. from 20° C. Piccard and Johner give its value as $0\cdot000131$ over this range. The relevant work of de Haas, Drapier, Sève and Piccard is closely reviewed. A full Bibliography is appended. S. G. B.

5250. Magnetic Behaviour of Oxygen. R. Einaudi. *Accad. Lincei, Atti,* 16. *pp.* 133–139, *Aug.*, 1932.—Gives experimental curves furnished by Schnurmann, of Hamburg, and embarks on a detailed theoretical investigation of the problem. A. D.

5251. Influence of Fluctuations of the Molecular Field on the Magnetic Properties of Bodies. L. Néel. *Ann. de Physique,* 17. *pp.* 5–105, *July–Aug.*, 1932.—In a mathematical study of the mechanism of the molecular field in solids, the author develops a theory based on the hypothesis of the existence of a potential energy due to the mutual action between carriers of magnetic moment. The second part of the paper deals with the experimental study of the paramagnetism of iron and a number of alloys. Among the general results an explanation of the difference between the two Curie points is given; an abnormal increase in the specific heat of ferromagnetics above the Curie point is indicated; an interpretation is given of the magnetisation curves of ferromagnetics, and of hysteresis and coercive force; and a theory of the constant paramagnetism of metals is developed. G. E. A.

5252. Electronic Constitution and Magnetic Properties of Copper Derivatives. S. S. Bhatnagar, B. Singh and A. Ghani. *Indian Journ. Phys.* 7. *pp.* 323–330, *Sept.* 1, 1932.—The magnetic susceptibilities of thirteen compounds of copper have been determined in solution and in the solid state. It has been shown that the copper compound, in which the central metallic atom or ion contains completed sub-groups, possesses zero magnetic moment and is diamagnetic, whilst those in which the sub-groups are incompletely filled are paramagnetic. AUTHORS.

5253. Magnetic Properties of Compounds of Molybdenum, Tungsten and Chromium. B. T. Tjabbes. *K. Akad. Amsterdam, Proc.* 35. 5. *pp.* 693–700, 1932.—An investigation of the magnetic properties

of compounds of the transition elements of the periodic system. A series of derivatives of Mo in its various stages of valency and of pentavalent W and Cr are considered here with respect to their magnetic behaviour. The following substances were found to be strongly paramagnetic: The chlorides, $MoCl_4$ and $MoCl_5$, the complex compounds of pentavalent Mo^{+5} and of trivalent Mo^{+3}. Also paramagnetic were the complex compounds of W^{+5} and Cr^{+5} containing $WOCl_3$ and $CrOCl_3$ respectively, and the perchromate of potassium, K_3CrO_8. All other compounds of Mo are either diamagnetic or weakly paramagnetic. In the compounds MoS_2 and $K_4Mo(CN)_8$ molybdenum is completely diamagnetic, hence the former is apparently completely saturated. The number of magnetons P_w of the paramagnetic compounds of Mo^{+5}, W^{+5}, Cr^{+5}, and of $MoCl_5$ is of the same order of magnitude as the value of V^{4+} for the iron group, which also contains one *d*-electron. Metallic Mo shows a weak and anomalous paramagnetism, and the calculation of the numbers of magnetons and the atomic susceptibilities at 17° C. for the different Mo ions, both from the Hund and the Bose-Stoner theories show better agreement with the former. There are, however, serious discrepancies to be explained. In the case of pentavalent Mo, a remarkable difference exists between those containing $MoOX_3$ and MoO_2X, in the former the P_w agrees with Mo^{5+}, and the compounds are paramagnetic, whilst in the latter case the compounds derived are diamagnetic. Pentavalent Cr evidently belongs to the ions of the elements of the iron group as regards magnetic behaviour.
S. G. B.

5254. Magnetic Susceptibilities of α- and β-Manganese. Mary A. Wheeler. *Phys. Rev.* 41. *pp.* 331–336, *Aug.* 1, 1932.—Pure α-manganese was prepared by distillation. β-manganese was prepared by melting a sample of the α-manganese in vaccum, and quenching it in water from about 1000° C. The mass susceptibilities of these two specimens were measured by a null-reading, astatic magnetometer, and found to be $9{\cdot}60(10)^{-6}$ and $8{\cdot}80(10)^{-6}$ respectively. These results eliminate the possibility that the ferromagnetic manganese found by some investigators is either the α- or the β-crystal form. AUTHOR.

5255. Magnetic Susceptibility of Nitrogen Dioxide. G. G. Havens. *Phys. Rev.* 41. *pp.* 337–344, *Aug.* 1, 1932.—A method has been developed whereby sensitivities for volume susceptibilities as high as 3×10^{-15} can be obtained. The main improvement in the method over that of other observers is in the construction of lighter test bodies and the use of smaller fibres. The method is applied to the measurement of the susceptibility of NO_2. The results agree within the limit of experimental uncertainties with van Vleck's theoretical value for the molecular susceptibility of NO_2, namely, $\chi(NO_2) = 0{\cdot}375\chi(O_2)$. The susceptibility of N_2O_4 comes in as a second order effect, and the value $\chi(N_2O_4) = -30 \times 10^{-6} \pm 20\,\%$ is in fair agreement with the value $\chi(N_2O_4) = -25{\cdot}8 \times 10^{-6}$ obtained by T. Soné [see Abstract 561 (1923)]. AUTHOR.

5256. Dependence of Susceptibility of Bismuth Single Crystals upon the Field. W. J. de Haas and P. M. van Alphen. *K. Akad. Amsterdam, Proc.* 35. 4. *pp.* 454–458, 1932. *Comm. No.* 220*d from the K. Onnes. Lab., Leiden.*—Extension of previous work using the larger magnet now available which enabled measurements to be taken to ± 35 kilogauss. In consequence of the large diameter of the calibration coil the

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accuracy of the determination of dH/dx is not satisfactory, resulting in values as measured being probably too low. At room-temperature the magnetisation increases linearly with the intensity of the field and for a direction perpendicular to the principal axis the value is given of the susceptibility as $1 \cdot 40 \times 10^{-6}$, which, as stated above, is too low. Rotation of the magnetic field round the direction of the principal axis has no influence on this value, and in the direction of the three binary axes the susceptibilities are equal. For intermediate directions another value is found. When the field is parallel with a binary axis a curve is found in the magnetisation at 14·5 kilogauss. When the field is parallel to the principal axis the value of the susceptibility, again low, was $- 1 \cdot 01 \times 10^{-6}$. At temperatures of 20°·4 K. and 14·2° K., when the field is parallel to a binary axis a decrease of the diamagnetic magnetisation is found at 12·5 kilogauss. For higher fields the magnetisation is approximately linear in variation, but between 21 and 28 kilogauss the rate of increase of magnetisation is retarded. For fields parallel to the principal axis the magnetisation of pure bismuth crystal (single) in the direction of the principal axis shows a normal behaviour and increases linearly with the field. The diamagnetic susceptibility seems to increase considerably when the temperature is lowered. S. G. B.

5257. Susceptibility and Electrical Resistance of Mixed Crystals of Pd/Ag and Pd/Cu. B. Svensson. *Ann. d. Physik*, 14. 6. *pp.* 699–711, *Aug.* 30, 1932.—The investigation covers the cases where in mixed crystals one of the components is strongly paramagnetic and the other diamagnetic. On the side of paramagnetic metals there is a strong decrease in the paramagnetic properties as would be expected in accordance with an additive mixture rule. The present work discusses experimental results on the susceptibility of Cu/Pd and Ag/Pd systems. The Johannsson and Linde method for measurement of resistance is followed, and the work is extended to cover both ordered and random orientation or molecular distribution within the crystals. In the case of the random distribution the curves covering the above systems as regards susceptibility are almost identical, and with the alloys containing less than between 30 to 35 % of Pd no paramagnetic portion of the susceptibility appears to exist. Whilst the resistance-concentration curves for mixed crystals of two diamagnetic metals, *e.g.*, Au/Ag, give a simple unbroken curve, those given in the present systems of dissimilar magnetic metals (Au/Pd, etc.) show a well-defined inflexion. This is accounted for by the hypothesis that in these cases where the alloy contains more than 30–35 % of Pd, the Pd atom exists in two states. The Cu/Pd alloy shows that in the range where an orderly distribution exists the susceptibility is lowered. Full details of experimental methods and results are given. S. G. B.

5258. Relation between the Electric and Diamagnetic Susceptibilities of Monatomic Gases. J. P. Vinti. *Phys. Rev.* 41. *pp.* 813–816, *Sept.* 15, 1932.—A relation is derived by quantum-mechanical perturbation theory, using a centre of gravity argument and the Kuhn-Reiche sum rule, between the polarisability and diamagnetic susceptibility of monatomic gases. On comparison with a similar paper by Kirkwood [see Abstract 2289 (1932)], who uses a variational method, a criterion is derived for the validity of a perturbed wave function of the form $\psi_0(1 + \lambda v)$, where ψ_0 is the unperturbed wave function of the normal state and v the perturbing potential energy of a uniform electric field. It is also pointed out that inclusion of an electronic interaction term σ neglected by Kirkwood removes a difficulty appearing in his paper. AUTHOR.

5259. Diamagnetic Susceptibility of Inorganic Compounds. Part II. Cu^+, Ag^+, Au^+, Zn^{++}, Cd^{++}, Hg^{++} and Hg_2^{++} Ions. K. Kido. *Tohoku Univ. Sci. Reports,* 21. *pp.* 288–297, *July,* 1932.—The specific susceptibilities of thirty-two salts of the above metals were measured [see Abstract 2999 (1932)], and the ionic susceptibilities (χ_{ion}) derived by using the additive law. The values found for $\chi_{\text{ion}} \times 10^{-6}$ were: Cu^+ 16·0, Ag^+ 26·2, Au^+ 44·8, Zn^{++} 12·8, Cd^{++} 20·3, Hg^{++} 36·6, Hg_2^{++} 2 × 40·3, CN^- 16·6. The relation between χ_{ion} and n the number of electrons in the ion is given by $\chi_{\text{ion}} = -cn \times 10^{-6}$, where c has the value 0·60 for ions of the Cu group and 0·46 for ions of the Zn group. The difference between the two mercury ions is considered to be a diamagnetic effect due to the shared electrons in the mercurous ion. G. E. A.

5260. Magnetic Susceptibility of Samarium Sulphate. F. H. Spedding. *Am. Chem. Soc., J.* 54. *pp.* 2593–2597, *July,* 1932.—The presence of electronic isomers in Sm^{+++} ions has been indicated by Freed, and further research shows that a new type of magnetic coupling is probably effective in the case of the rare earths. It appears from a comparison of experimental and calculated values of χ that the excited electronic isomers of $Sm(SO_4)_3 . 8H_2O$ consist of $4f^6 5g$, $4f^6 5f$, $4f^6 5d$ configurations, where the $4f^6$ electrons combine among themselves, and the resultant couples firmly with the orbit of the excited electron, which itself is firmly coupled with the electric field of the crystal lattice. Only the spin of the external electron contributes to the susceptibility, and all excited terms have a Curie constant of 0·3724. G. E. A.

5261. Influence of Plastic Deformation upon the Susceptibility of Dia- and Paramagnetic Metals. A. Kussmann and H. J. Seemann. *Zeits. f. Physik,* 77. 9–10. *pp.* 567–580, *Aug.* 24, 1932.—The influence of plastic deformation, such as may be obtained by drawing, hammering, etc., upon the susceptibility of a number of metals and alloys is determined. The first group embraces Cu, Ag, Bi, Pb, Brass and Cu/Zn alloys, and shows considerable alteration of the susceptibility with cold deformation, which acts in the direction that increasing magnetisability (*i.e.*, decrease of dia- and increase of paramagnetism) in the series increases the effect. In the case of copper and brass the cold deformation alone can cause a transition from the dia- to the paramagnetic state. The second group of metals examined included Al, Au, Zn, W, Mo, as also Cu/Zn/Ni alloys, and in this case the susceptibility remained practically unaltered. The observed differences are attributed to the presence of insignificant quantities of ferromagnetic materials, particularly traces of iron, which even the purest of the metal samples contained. The necessary condition is that at ordinary temperatures an almost invisible solubility of a ferromagnetic phase exists, a strong increment as indicated by a sharp upward slope of the solubility curve with increasing temperature, and by cooling the sample a supersaturated solid solution must be built up. By cold deformation the equilibrium condition in the sample will be set up, the excess iron appears in the form of free ferromagnetic particles, and thus effects the observed alteration in susceptibility. The correctness of this hypothesis is seen by the different behaviour of the two groups, since group 1 fulfils these conditions, and group 2 does not do so. The dependence of the effect upon the iron content, the saturation character of the deformation-susceptibility curve and the knowledge of the relationship between the field strength and the susceptibility in the case of cold-drawn copper are quoted as evidence of the validity of the arguments proposed. An electronic theory of structure is further quoted to account for the dia- and paramagnetic phenomena which coincide with the plastic deformation. S. G. B.

5262. Influence of Crystalline Fields on Salts of Paramagnetic Ions. Part I. Rare Earths, especially Pr and Nd. W. G. Penney and R. Schlapp. *Phys. Rev.* 41. *pp.* 194–207, *July* 15, 1932.—A mathematical investigation of the susceptibilities of Pr and Nd on the assumption that the potential of the electric field of the atoms surrounding the metallic ion can be represented by a Taylor expansion. The introduction of an electric field causes a splitting of levels and a redistribution of magnetic moment with consequent change of susceptibility. The theoretical interpretation of the Curie-Weiss law is discussed. The hydrated sulphates of Pr and Nd are considered, and agreement is obtained with the experimental results of Gorter and de Haas for the variation of susceptibility with temperatures. G. E. A.

5263. Theory of Variations in Paramagnetic Anisotropy of Salts of the Iron Group. J. H. van Vleck. *Phys. Rev.* 41. *pp.* 208–215, *July* 15, 1932.—An explanation is given of the fact that Ni salts are nearly isotropic magnetically, while those of Co exhibit over 25 % of anisotropy, even though the Ni^{++} and Co^{++} ions are both in F states and are adjacent in the periodic table. The theory predicts that hydrated Ni salts will conform more closely to Curie's law than those of Co. Other pairs of ions in the iron group are cited in which the inversion phenomenon is encountered, with attendant diversity in magnetic behaviour. G. E. A.

5264. Variability of the Magnetic Moments of Ions in Elements of the Iron Series. H. Fahlenbrach. *Ann. d. Physik*, 14. 5. *pp.* 521–523, *Aug.* 15, 1932.—A correction of previous work [see Abstract 3434 (1932)]. The values for the actual density of the solution do not come into the question, but the density derived from the determination of the concentration at room-temperature. This correction is applied in the present note and the results revised in accordance therewith. [See following Abstract.] S. G. B.

5265. Relation between the Constants C and θ of Weiss Law, and Dependence of Magnetic Moment Cr^{+++} in Aqueous Solution of Violet $Cr(NO_3)_3$ on the Concentration. H. Fahlenbrach. *Ann. d. Physik*, 14. 5. *pp.* 524–530, *Aug.* 15, 1932.—Earlier work has shown that the dependence on concentration of the magnetic moments of Cr^{+++} is in the opposite direction to that of Co^{++} and Ni^{++}. The present paper gives the explanation of this point. With strong concentrations a space or structural complex is built up with the anions, so that the magnetic ionic moment is little different from the value as given by the Bose theory. With decreasing concentration (free ions) the ionic moments approximate to those given by the Hund theory. Upon the basis of the results of the former experiments on various materials (ions of the iron series) the connection between θ and M^2 is deduced. It is shown that for each particular salt there is a quite definite relationship between θ and M which is characteristic of the salt. This relationship is unaltered by different modifications of the same salt. Thus $CoCl_2$ in water and in pyridine give the same linear relationship. [See preceding and following Abstracts.] S. G. B.

5266. Linear Relation between Curie Constant and Curie Point for Chlorides of Nickel and Cobalt in Solution and Their Magnetic Varieties. G. Foëx. *J. de Physique et le Radium*, 3. *pp*. 337–344, *Aug*., 1932.—In spite of the previous work upon magnetic varieties, the work of Fahlenbrach [see two preceding Abstracts] has not included the full significance of certain of his results, *e.g.*, the existence of new magnetic varieties and the verification of the linear law connecting the Curie paramagnetic point with the Curie constant. The present work analyses the Fahlenbrach results afresh from these points of view, and relates them to the known properties of ions of multiple varieties. The influence of the initial concentration of the solutions on their magnetic condition is attributed to a known paramagnetic characteristic, namely, the tendency towards uniformity of moments. Perfect agreement with the Weiss law is established and the results are shown to be in confirmation of the principles enunciated above. S. G. B.

5267. Interpretations of the Curie–Weiss Law. C. J. Gorter. *Phys. Zeits*. 33. *pp*. 546–547, *July* 15, 1932.—There are three possible interpretations, each of which appears to fit certain cases. In the first, the classical view of the Weiss molecular field leads to the above law. The modern formulation of this view is perhaps that the existence of a quantum-mechanical resonance effect between the magnetic ions is assumed. Secondly, in the absence of reactions between the magnetic ions, a Boltzmann distribution over several levels will lead to the law in question. The third view assumes that the magnetic moment is a slowly changing function of the temperature. G. E. A.

5268. Law of Additivity for Diamagnetism. D. P. Ray-Chaudhuri. *Zeits. f. Physik*, 77. 3–2. *pp*. 271–274, *July* 26, 1932.—The law is tested for a series of hydrated salts for which the susceptibilities were measured by a Curie–Cheneveau balance. Deviations from the law are found which are proportional to the heats of hydration of the substances investigated. G. E. A.

5269. Magnetostriction. F. Lichtenberger. *Zeits. f. Physik*, 77. 5–6. *pp*. 395–397, *Aug*. 2, 1932.—Careful measurement of the magnetostriction glide-off in hard nickel shows that there is a hysteretic remanence of the magnetostriction and a change in its sign as the steepness of its descent falls off. A. D.

5270. Theory of Magnetostriction. T. Hayasi. *Tohoku Univ., Sci. Reports*, 21. *pp*. 268–287, *July*, 1932.—It is proved mathematically that the lattice energy of a magnetised crystal depends on the external form of the crystal mass. The dependence of the magnetostriction on the form of the crystal is explained by means of an example. G. E. A.

5271. Reversible Effects in a Magnetic Material under Strong Internal Strains. R. Becker. *Wiss. Veröff. a. d. Siemens-Konzern*, 11. 2. *pp*. 1–11, 1932.—A note containing the mathematical basis of the method of calculation of the effects due to torsion and the magnetic consequences arising therefrom. From the physical point of view the present work confirms in general the already considerable number of results and knowledge obtained by the earlier and more cumbersome methods. The work is intended to summarise the present position from a concise mathematical standpoint. S. G. B.

5272. Permeability of a Vacuum and Chipart's Theorems. J. Cayrel. *Comptes Rendus,* 195. *pp.* 366–368, *Aug.* 1, 1932.—If the ether (vacuum) is polarisable then by making measurements of magnetic forces in the ether and in an incompressible material fluid it is possible to determine the permeability of the ether. It is shown that if it were experimentally possible to obtain a value for the permeability different from unity, then, as a consequence of a theorem by Chipart, it would be unnecessary to assume the ether to be magnetic in space outside magnets if certain conditions are assumed. H. L. B.

5273. Anomalous H.F. Permeability of Iron. G. R. Wait. *Zeits. f. Physik,* 77. 9–10. *pp.* 695–698, *Aug.* 24, 1932.—Malov and Arkadiew have expressed the view that their results obtained in 1927 with the heterodyne alternating method have shown a systematic decrease of permeability with decreasing frequency. This view is not confirmed by the experiments of the present author. The main conclusion of the present work is that no anomaly can be found in the permeability of iron between 3500 and $2 \cdot 50 \times 10^6 \sim$. New results obtained by the resonance method are published for the first time concerning the relationship between permeability and frequency and the effects of eddy currents. The latter can apparently, as shown by this method of investigation, cause great alterations in the permeability with frequency. S. G. B.

5274. Rotating Hysteresis. J. v. Harlem. *Ann. d. Physik,* 14. 6. *pp.* 667–674, *Aug.* 30, 1932.—When a circular disc of ferromagnetic material rotates about its axis in a constant homogeneous field, parallel to the plane of the disc, I lags behind H, making with it a constant angle ψ_s. With increase of B, ψ_s rises to a maximum, and ultimately becomes zero. The material used was a small thin disc of tungsten steel which was tested in the hard and soft conditions. An account is given of the manner in which the angle of lag ψ varies between its end values when the direction of rotation is reversed. G. E. A.

5275. Influence of a Superposed Magnetic Field upon Dielectrics. R. Schmid. *Ann. d. Physik.* 14. 7. *pp.* 809–830, *Sept.,* 1932.—The investigation embraces a study of the experimental results to discover how strongly the breakdown of air at atmospheric pressure, the dielectric current in insulating materials, as also the breakdown of thin layers of insulating material, is influenced by a superposed magnetic field. A method of measurement is described wherein the energy sources of the magnetic and dielectric phenomena are absolutely independent of each other. There was no evidence of the influence of the magnetic field upon a thin sheet or layer of solid insulating materials up to a field of 14,000 gauss. No effect was observed upon the current in a dielectric liquid at very high field strengths up to a maximum of 11,700 gauss. A superposed magnetic field affected the spark length of a discharge in air at atmospheric pressure, although no influence could be detected upon the static potential for breakdown of the dielectric. If the field is applied across the spark path, then the latter is increased; if along the spark path then a decrease is noted. In the length direction a decrease in the breakdown potential of as much as 25 % was observed at 14,000 gauss. The extent of the effects due to the magnetic field depend largely upon the material under test and the form of the kathode surface. The effects of the magnetic field were not observable when the value of the field fell below 2000 gauss. From the results obtained it is suggested that there is a parallelism between the above magnetic effects and the optical-electrical effects at atmospheric pressure. S. G. B.

5276. Mechanism and Determination of Magnetic Doublets. R. Forrer and J. Martak. *J. de Physique et le Radium*, 3. *pp.* 408–436, *Sept.*, 1932.—The author discusses his hypothesis of magnetic doublets (by which the atomic moment, μ, is subdivided into constituent moments), and describes a series of experiments upon Fe, Ni and Co which, he believes, place the truth of the hypotheses beyond all doubt. The following multiplets are proposed: Ni, a doublet at right angles; Fe, two types of triplets, the type depending upon the crystalline structure; Co (hexagonal), a quadruplet of two types; Co (γ), a quadruplet of three types. The following properties of the multiplets are given: (1) They may be deformed by intense fields, and the deformation is reversible; (2) They possess normal positions in the lattice. External fields may cause rotation, but this is opposed by an internal field; (3) The rotation is irreversible; (4) There are two inversion mechanisms; (5) A position of instability may be reached, and is succeeded by a rotation of the multiplet. The paper concludes with a discussion of the nature of the multiplets. J. E. R. C.

5277. Magnetic Field Intensity near a Circular Loop Carrying a Current. A. L. Fitch. *Frank. Inst., J.* 214. *pp.* 215–221, *Aug.*, 1932.—An entirely mathematical paper in which the author deduces an exact and general formula for the field at any point near a loop which carries a current. A table of some representative values is given. J. E. R. C.

5278. Precision Formula for Inductance of Helix. C. Snow. *Bureau of Standards, J. of Research*, 9. *pp.* 419–426, *Sept.*, 1932.—A precision formula is here given for the self-inductance of a single-layer helix wound with ordinary round wire. This is neither more nor less accurate than that previously published, from which it has been derived by evaluating certain correction terms and replacing them by approximation formulæ which are much simpler to compute. AUTHOR.

5279. Determination of the Ohm in Absolute Value. E. Giebe. *Congrès International d'Électricité, Paris, Sect.* 2. *Rapport No.* 3. [18 *pp.*], 1932.—An historical account of the various determinations of the absolute value of the ohm. These include the complete determinations of high precision made at the National Physical Laboratory and the Physikalisch Technische Reichsanstalt in 1914 and 1920. As mean of these German and English determinations the most probable value is:

$$1\,\Omega\ \text{(international)} = 1\cdot00050\,\Omega\ \text{(absolute)},$$

with a probable error of about ±2/100,000. The precision is about 10 times superior to that of the values of 1893. At the present time the absolute unit of resistance can be reproduced with about the same precision as the mercury unit. J. J. S.

5280. Absolute Measurement of Current. H. L. Curtis. *Congrès International d'Électricité, Paris, Sect.* 2. *Rapport No.* 4. [21 *pp.*], 1932.—An account of the measurements which have been made to determine the unit of current in absolute measure. At present researches are in progress in several national laboratories for the absolute determination of the ampere. J. J. S.

5281. Measurement of Standards of Inductance. H. L. Curtis. *Congrès International d'Électricité, Paris, Sect.* 2. *Rapport No.* 8. [27 *pp.*], 1932.—A summary of the work which has been done in various countries on the measurement of working standards and absolute standards of inductance. Standards of inductance can be constructed so that the inductance can be calculated, starting from dimensions measured with a precision of some millionths. Ordinarily two self-inductances can be compared with more precision than two mutual inductances, and a self-inductance can be measured with more precision in terms of capacities and resistances than a mutual inductance. J. J. S.

5282. Present Position of the Electromagnetic Theory. L. de Broglie. *Congrès International d'Électricité, Paris, Sect.* 1. *Rapport No.* 16. [16 *pp.*], 1932.—The author traces the development of electromagnetic theory in its successive steps: Maxwell's equations; Lorentz's theory of electrons; difficulties associated with the intrinsic energy of the electron and the emission of radiation by quanta; Bohr's correspondence principle and wave mechanics; and quantum theory of the electromagnetic field. W. S. S.

5283. Force between Moving Charges. A. D. Fokker and C. J. Gorter. *Zeits. f. Physik,* 77. 3–4. *pp.* 166–169, *July* 12, 1932.—It is shown that the formula deduced by Güntherschulze for the forces between moving charges is very different from that obtained from classical considerations. It is also not in agreement with the consequences of the special relativity theory. J. E.

5284. Point Charge in Moving Medium. H. F. Biggs. *Roy. Soc., Proc.* 137. *pp.* 592–603, *Sept.* 1, 1932.—An analogy is traced between the equations of motion of a point charge in the electromagnetic field and that of a sound pulse in a medium moving with varying velocity, both being derived by the same development from similar Fermat principles. It is shown that for two-dimensional motion the curvature of the path can be deduced very simply from the Fermat principle. This principle is explicitly connected with the de Broglie waves, these waves being considered stationary in space-time while any particle moves across them with the fundamental velocity. A differential equation is derived for the wave-function of a point-charge, analogous to Dirac's differential equation but containing only vector and scalar quantities. E. E. F. d'A.

5285. Sub-Electronic Charges. F. Ehrenhaft. *Congrès International d'Électricité, Paris, Sect.* 1. *Comm. No.* 0C. [8 *pp.*], 1932.—The writer describes briefly determinations of the charge carried out by a falling particle in a gas by Millikan's method, but with the modification that the gas pressure was varied up to a value of 25 atmospheres. This modification reduces the magnitude of the correction which has to be made in Stokes' formula when applied to gases. For particles of gold and silver, in certain cases values for the electric charge carried were obtained which were sensibly inferior to that of the electron. W. S. S.

5286. Electrons, Protons and Electromagnetism. E. Klein. *Zeits. f. Physik,* 77. 5–6. *pp.* 415–419, *Aug.* 2, 1932.—Criticism of a paper by Güntherschulze [see Abstract 3010 (1932)]. The author points out that the problem has already been treated by Weber in 1848 and by

Clausius in 1877, although naturally in rather different form. The fundamental difference between the development of Weber and of Clausius lies in that the former considered the relative motion of changed bodies, and the latter considered their absolute motion. It is suggested that the claims of the two theories can only be tested by direct experiment, and a possible method of experiment, involving a study of the behaviour of ions in a coloured electrolyte, is outlined. G. E. B.

5287. Undulatory Character of the Electron. C. J. Davisson. *Congrès International d'Électricité, Paris, Sect.* 1. *Rapport No.* 3. [21 *pp.*], 1932.—The author reviews the historical development of the conception of the electron as fundamental unit quantity of electricity, as a particle of well-defined mass and charge and as a wave process. The rest of the paper contains descriptions of typical experiments illustrating the wave character of electron pencils, their diffraction, refraction and polarisation. W. S. S.

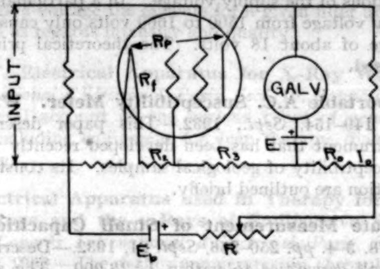
5288. Applications of the Diffraction of Associated Waves. M. Ponte. *Congrès International d'Électricité, Paris, Sect.* 1. *Rapport No.* 4. [15 *pp.*], 1932.—Following a general statement of the differences in properties between X-rays and the waves associated with electrons, the author stresses the advantages of the latter in the analysis of crystal structure, surface structure and the structure of atoms and molecules. Electron waves give much more intense diffraction than X-rays so that less material and shorter exposure times are required. A homogeneous beam of any desired wave-length is easily obtained. The energy dissipation in electron-wave apparatus is small, and the protective measures essential in X-ray work are unnecessary. W. S. S.

APPARATUS AND INSTRUMENTS.

5289. Natural Limits of Sensitiveness of Measuring Instruments. Part III. Galvanometers. G. Ising. *Ann. d. Physik,* 14. 7. *pp.* 755–789, *Sept.,* 1932.—The theoretical limits of sensitiveness can be obtained with the coil galvanometer directly without arrangements of relays if very strong optical magnification of the deflection is employed in which diffraction fringes serve as reading marks. The principles of construction are described of a pointer galvanometer of small size that can be placed on the table of an ordinary microscope. By means of an ultra-microscopic arrangement sharp diffraction fringes were obtained which by 2000-fold magnification had about 0·96 mm. breadth. Thus good photographic records of the Brownian vibrations of a galvanometer coil could be obtained. [For Part II see Abstract 3599 (1931).] J. J. S.

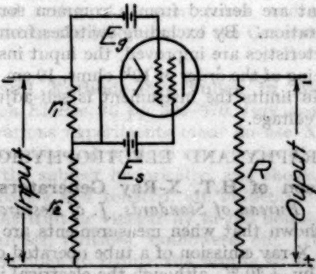
5290. Small Electromagnet. S. R. Williams, W. W. Stifler and T. Soller. *Rev. Sci. Instruments,* 3. *pp.* 423–426, *Aug.,* 1932.—A description of a small electromagnet suitable for students' use. The core is of the usual ⊔-shape, of a high-grade iron known as "Rema" iron. The pole pieces are of the same iron, and fit snugly into holes in the core, and are finished with windings each consisting of about 2600 turns of No. 12 D.C.C. wire. Using a 1 cm. air gap and about 8 amperes magnetising current, a field of about 18,000 gauss is obtained in the centre. G. E. B.

5291. Valve-Balanced Circuit for Amplifiers of Very Small Direct Currents. W. Soller. *Rev. Sci. Instruments,* 3. *pp.* 416–422, *Aug.,* 1932.—Describes an arrangement of a screened-grid valve for use either as a sensitive galvanometer or an electrometer. Mathematical investigation into the circuit shown in the figure shows that the balance of the galvanometer is largely determined by the values of the various resistances, and that suitable values of R_0 and R_1 (the values depending on the particular valve) make the balance nearly independent of variations in the filament current. Used with reasonable care, it is stated that, as a galvanometer, the system will read currents to 5×10^{-14} ampere, and as an electrometer it will read currents to 10^{-15} ampere. With more elaborate precautions, and the provision of a means of neutralising internal grid current, the sensitivity can be increased to 10^{-16} ampere. G. E. B.



5292. Rotary Voltmeter. P. Kirkpatrick. *Rev. Sci. Instruments,* 3. *pp.* 430–438, *Aug.,* 1932.—Later developments are described of a voltmeter introduced in an earlier paper [see Abstract 2146 (1932)]. Diagrams and structural details are given. From a number of tests upon one of the instruments a series of photographic records illustrate concurrently the response of the voltmeter to high potentials and the behaviour of the h.t. power plant by which the measured potentials are generated. H. M. B.

5293. Use of Tetrode for Voltage Control. J. C. Street and T. H. Johnson. *Frank. Inst., J.* 214. *pp.* 155–162, *Aug.*, 1932.—Describes an arrangement, consisting of one or more screened-grid valves, designed to control the voltage of a supply delivering only a small current. Several possible arrangements are mentioned, a satisfactory one being shown in the figure. The resistances r_1 and r_2 (2000 ohms and 2 megohms respectively) are connected across the supply (which may be d.c. or rectified and



smoothed a.c.), and the voltage developed across the resistances is applied to the plate and working grid, the potential to the screening grid being supplied by a battery. In these circumstances the valve passes a sensibly constant current, and hence the potential across R remains largely independent of variations of the supply voltage. In a particular case, a variation of the supply voltage from 1500 to 1660 volts only caused a variation of output voltage of about 18 volts. The theoretical principles of the circuit are discussed. G. E. B.

5294. Semiportable A.C. Susceptibility Meter. W. M. Barret. *Physics*, 3. *pp.* 149–154, *Sept.*, 1932.—This paper describes a semiportable a.c. instrument that has been developed recently for measuring the magnetic susceptibility of geological samples. Its construction, basic theory and operation are outlined briefly. AUTHOR.

5295. Accurate Measurement of Small Capacities. J. Clay. *Zeits. f. Physik*, 78. 3–4. *pp.* 250–256, *Sept.* 21, 1932.—Describes a method of measuring small capacities to within 1 : 13,000. The standard condenser is made of two cylinders of stainless steel, one displaced inside the other by means of a micrometer screw, and another cylindrical piece fixed in the axis of the outer cylinder with an airtight joint. Any air displaced from within the apparatus is received and stored in a rubber bag attached to the end plate of the outer cylinder. The capacity can now be measured of an electrometer with an internal insulated system, leaving the probe out of account. E. E. F. d'A.

5296. Quantitative Thermoelectric Magnifier for Optical Pointers. J. H. Jeffree. *Phil. Mag.* 14. *pp.* 366–372, *Sept.*, 1932.—A simple device is described for magnifying deflections of optical pointers, giving large magnification which is independent of fluctuations in illumination intensity. AUTHOR.

5297. Portable Thermionic Electrometer for Glass-Electrode Potentials. C. Morton. *Journ. Sci. Instruments*, 9. *pp.* 289–293, *Sept.*, 1932.—A portable thermionic electrometer, with self-contained potentiometer, standard cell and robust pointer galvanometer, is described. Potentiometer current, grid bias, filament current, anode voltage and compensating current are derived from a common source and are standardised in one operation. By excluding switches from the input circuit the electrical characteristics are improved, the input insulation resistance, capacity and load being of the order of 10^{15} ohms, 10 cm. and 10^{-16} ampere respectively. Within limits the instrument is self-adjusting for fluctuations in the battery voltage. AUTHOR.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

5298. Comparison of H.T. X-Ray Generators. L. S. Taylor and K. L. Tucker. *Bureau of Standards, J. of Research*, 9. *pp.* 333–352, *Sept.*, 1932.—It is shown that when measurements are made in the customary manner, the X-ray emission of a tube operated on two mechanical rectifiers may differ by ±20 %, although the electrical indications are the same. This also applies to quality evaluations, whether of the full absorption curve, half-value layer or effective wave-length type. Determinations of percentage depth dose do not show any such marked differences, since this is a comparatively insensitive indicator. It is seen, moreover, that there is little gain in percentage depth dose in going from 160 to 200kV peak; the only change of significance being in the actual 10-cm. depth dose. It is shown on the other hand when the potential of three generators, including constant potential, is measured in "effective kilovolts," that for the same effective voltage the outputs for a given filter are all very nearly the same, both as regards intensity and quality. AUTHORS.

5299. H.T. Electrical Apparatus for X-Ray Work. J. Saget. *Congrès International d'Électricité, Paris, Sect.* 10. *Rapport No.* 3. [24 *pp.*], 1932.—A general account of the various types of generators used for X-ray work, including equipment for deep therapy, diagnostic work and crystallography. G. E. B.

5300. Electrical Apparatus used in Therapy for the Measurement of X-Rays and the γ-Rays of Radioactive Substances. A. Dauvillier. *Congrès International d'Électricité, Paris, Sect.* 10. *Rapport No.* 4. [8 *pp.*], 1932.—The author enumerates, in chronological order, the various methods and electrical apparatus which have been proposed or constructed for the quantitative measurement of γ-rays and X-rays. In the case of X-rays the ionisation produced in a small chamber, generally filled with air, is measured by means of an electrometer or galvanometer. For γ-rays the problem still awaits solution, though interesting attempts have been made to express the doses of γ-rays in *r* units or c.g.s. units of energy. The paper contains a valuable Bibliography on this subject. W. V. M.

5301. X-Ray Apparatus. R. J. M. Tozer. *Brit. J. of Radiology*, 5. *pp.* 631–639, *Aug.*, 1932.—A discussion of the significance of meter readings on X-ray apparatus, using different types of rectification. W. V. M.

5302. Modern X-Ray Tubes. W. D. Coolidge and E. E. Charlton. *Congrès International d'Électricité, Paris, Sect.* 10. *Rapport No.* 2. [14. *pp.*], 1932.—The authors describe the development of the modern filament tube. The original work of Coolidge on the production of ductile tungsten is described and the use of tungsten filaments and antikathodes is discussed. Most of the paper deals with the physical principles underlying the construction and action of filament tubes, and is based largely on researches carried out in the laboratory of the General Electric Company. J. T.

5303. X-Ray and Kathode-Ray Tubes in Biological Service. C. P. Haskins. *Gen. El. Rev.* 35. *pp.* 367–370, *July, and pp.* 465–471, *Sept.*, 1932.—Describes various experiments made to use X-rays and kathode rays to influence heredity and produce new species of plants and animals. Part I introduces the subject historically, and shows how many plants, including cotton, barley and tobacco, are influenced. Part II discusses the mutations of the fruit or vinegar fly in full detail, and also describes experiments on narcissi, radishes, sunflowers, etc. It is concluded that much remains to be done to reduce the results to simple laws, and that certain processes remain obscure. G. E. B.

5304. X-Ray Tubes with Incandescent Filaments. H. Pilon. *Congrès International d'Électricité, Paris, Sect.* 10. *Comm. No.* 2C1. [7 *pp.*], 1932.—The author describes three types of modern filament tube, exemplifying the way in which research has radically modified the original Coolidge tube. J. T.

5305. Protected X-Ray Tube of "Japanix" Type. M. Tanaka. *Congrès International d'Électricité, Paris, Sect.* 10, *Comm. No.* 2C2. [4 *pp.*], 1932.—A description of a self-protected X-ray tube of Japanese origin. G. E. B.

5306. Measurement of the Phase of Voltage and Current in an X-Ray Tube. C. Weyl. *Congrès International d'Électricité, Paris, Sect.* 10. *Comm. No.* 4C. [13 *pp.*], 1932.—Points out the importance of reliable measurements of voltage and of current in diagnostic X-ray work. Several methods of measuring voltage are mentioned, including the electrostatic voltmeter, the spark gap, potential dividers and the spectroscopic method. The difficulties of measuring currents in the time available are mentioned, and the importance of oscillographic examination is stressed. G. E. B.

5307. Quantum Interpretation of Cellular Radiosensitivity. F. Holweck. *Congrès International d'Électricité, Paris, Sect.* 10. *Rapport* 5, [15 *pp.*], 1932.—X-rays and ultra-violet light may usually be considered as continuous, but show their discontinuous structure when they act on monocellular organisms, the cells being small enough and sensitive enough to perceive the individual action of quanta. The laws of probability apply to the irradiation of a large number of individuals, the "projectiles" having radii of action whose values vary with the wave-lengths employed. The size of the sensitive area may be deduced statistically, and experiments are described on Polytoma uvella and Saccharomyces ellipsoideus. The entire volume of the cell is not uniformly sensitive, "hits" in different portions of the cell producing different effects. Thus the cytoplasm may receive a number of quanta without becoming incapable of continuing its functions, while the chromatin is seriously affected by few "hits" which are sufficient to alter profoundly the character of the reproduction, making only the first division possible. The centrosome may be irreparably damaged by one "hit." The volume of the sensitive zone and the minimum number, 3, of "hits" necessary to produce a lesion are the two factors defining the radiosensitivity. They are generally functions of the wave-length. In many cases by such statistical methods it is possible to determine the sensitive volume of a micro-organism, even though the latter be below the limits of microscopic vision. An excellent and valuable review of the subject. W. V. M.

5308. Balanced Thermocouple Radiometer for Ultra-Violet Dosage Meter. W. W. Coblentz, R. Stair and J. M. Hogue. *Bureau of Standards, J. of Research,* 8. *pp.* 759–776, *June,* 1932.—Data are given on the accuracy of the balanced thermocouple and filter radiometer as a standard ultra-violet dosage intensity meter. The erythema produced by the radiometrically-measured amount of heterogeneous (ultra-violet) radiation is compared with that produced by a measured amount of homogeneous radiation of the emission line of mercury at 297 mμ, which is used as a standard. A close agreement is found between the erythemogenic efficiency, determined physiologically and radiometrically, of all the sources examined, including as extremes the sun and the so-called cold quartz mercury-vapour lamp. For an erythemogenic unit of dosage 10,000 ergs/cm.^{2} of homogeneous radiation of the emission line of mercury at 2967 Å. is suggested. F. S. B.

5309. Distribution of Radiation around Simple Radioactive Sources. W. V. Mayneord. *Brit. J. of Radiology,* 5. *pp.* 677–715; *Disc.,* 715–716, *Sept.,* 1932.—The distribution of radiation around various types of source is investigated mathematically, making use of simple inverse square law considerations. Combinations of point sources are discussed, and diagrams given of intensity contours. The simple line source and a line source surrounded by a platinum absorbing sheath are next investigated, and it is shown that certain directions receive very small amounts of radiation. These mathematical conclusions are shown to be in qualitative agreement with photographic experiments on the subject. A radium container designed to give better distribution of radiation for therapeutic purposes is described. Combinations of infinitely long line sources are next discussed, and the analogy between intensity contours and normal electrostatic equipotentials is developed and examples given. The distribution about circular ring sources, spherical shells and point sources on spherical surfaces, plane circular sources, and annular sources is investigated. The paper also contains the solution to the distribution about an infinitely long strip and a partial solution to that near rectangular sources. W. V. M.

5310. Radiothermy. W. R. Whitney. *Congrès International d'Électricité, Paris, Sect.* 10. *Comm. No.* 8*C.* [9 *pp.*], 1932.—The development and study of vacuum tubes has had important practical results, one of which is in the possibility of developing h.f. oscillations for medical applications. A body having resistance, situated between the plates of a h.f. apparatus having a frequency of about 10 million ∼, is heated to a definite degree. Patzold, McLennan and Burton have studied the relationship between the elevation of temperature, the frequency and the resistance. Hosmer has studied the influence of such fields upon saline solutions and gelatinous bodies. Those studied have an importance in respect to the action upon blood. The present author has studied the influence of such h.f. fields in living tissue in respect to insects and small mammals, and has found the effects are purely thermic. Carpenter, who was interested in syphilis, has studied the effects of h.f. upon syphilitic rabbits, and these results have been extended to the human being. Investigations of Knudson promise interesting results in the application of h.f. energy in order to produce artificial fever, with a view to extending the treatment to those pathological conditions which respond to increase of temperature of the body, *i.e.*, arthritic conditions, certain tumours and other affections. It is necessary to consider the local effects of heat, which occur with variations of the forms of the electrodes and of the frequency of oscillation, in order to produce maximum effects and, in this respect, the author has collaborated with his medical colleagues. B. J. L.

5311. Calculations and Measurements of Power of Short-Wave Thermotherapeutic Energy. M. Poittevin. *Congrès International d'Électricité, Paris, Sect.* 10. *Comm. No.* 8*C*2. [7 *pp.*], 1932.—The therapeutic applications of electrical fields of very high frequency are becoming more and more important. By this means internal heat may be produced in an organism which has received the name of " artificial fever " and has important therapeutic effects. The author shows how the amount of heat absorbed by the organism may be calculated and measured. The advantage of very short wave-lengths is demonstrated, up to a wave-length of 3 m., but practical difficulties of obtaining sufficient energy values necessitates the employment of apparatus with longer wave-lengths. Calculation of the energy is discussed on mathematical grounds, and a particular apparatus to measure the value is described. B. J. L.

5312. Theory of Electrical Excitation. L. Lapicque. *Congrès International d'Électricité, Paris, Sect.* 10. *Rapport No.* 8. [15 *pp.*], 1932.—A theoretical survey of the laws relating to and mechanism of electrical excitation of nerves. W. V. M.

5313. Improved Form of Electrocardiograph. S. H. Caldwell, C. B. Oler and J. C. Peters, Jr. *Rev. Sci. Instruments,* 3. *pp.* 277–286, *June,* 1932.—An electrocardiograph is described which has been designed to secure a more nearly uniform response characteristic, as a function of frequency, over the desired frequency range, than is obtainable with the Einthoven string galvanometer ordinarily used for this work. It is shown by harmonic analysis that relatively h.f. components are present to a large degree in the ordinary electrocardiogram, and, due to their magnitudes, have a large influence on the shape of the wave. More accurate interpretation of the electrocardiograph record is desirable, and is made possible by using an amplifier in conjunction with a standard type of oscillograph to produce a larger record, without reducing the accuracy at higher frequencies. The valve amplifier was specifically designed for the purpose. It has a high input impedance so that the effect of body resistance is negligible. A standardising circuit is built into the amplifier so that calibrations can be obtained readily. Illustrations from tests are included, showing comparisons between records obtained from a standard type of string galvanometer electrocardiograph and from the new apparatus. AUTHORS.

5314. Modern Methods of Registering Transitory Electrophysiological Phenomena. A. M. Monnier. *Congrès International d'Électricité, Paris, Sect.* 10. *Rapport No.* 6. [27 *pp.*], 1932.—After a short historical sketch of the development of electrophysiological phenomena the author describes in fair detail forms of apparatus at present in use, beginning with the capillary electrometer. The theory of the string galvanometer is touched upon, and it is pointed out that the natural frequency is still too low for some purposes, and that the increase of tension of the fibre to compensate this lowers the sensitivity beyond the limits of usefulness. This difficulty may be overcome by means of valve amplification. The Blondel oscillograph is useful but of too low internal resistance to make amplification easy. The soft-iron oscillographs of Matthews and Dubois are then described and advantages and difficulties set forth. The kathode-ray oscillographs suitable for physiological experiments are then described, the chief difficulty being the low voltage sensitivity, *i.e.*, the deviations of the electron beam are very small for the voltages of interest. The work of Johnson and Gosser and Erlanger has, however, placed the experimental technique on a sound basis by designing apparatus (involving Wehnelt kathode and amplifying systems) of a very valuable character which has, for instance, enabled direct verification of the variation of velocity of propagation with the diameter of a nerve to be made. Details are given of experimental improvements due to Ardenne and Goudet, while the last section of the paper is devoted to a discussion of the technique of amplification. A valuable source of experimental information. W. V. M.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

5315. Adsorption at the Surface of Solutions. J. A. V. Butler, A. Wightman and A. D. Lees. *Chem. Soc., J. pp.* 2089–2104, *Aug.*, 1932.—The surface tensions of aqueous EtOH solutions and of EtOH, aq., LiCl solutions have been measured at 25° C. The values of the former agree with the earlier measurements of Bircumshaw. For binary solutions it is shown that $\Gamma_2 = n_2 - n_1 N_2/N_1$, where Γ_2 is the Gibbs surface excess of the component indicated by the suffix 2, N_2 and N_1 molar fractions of the components in the bulk, and n_2 and n_1 the amounts of the components at any given distance from the interface. If the additional assumption of a monomolecular adsorption is made $\Gamma_2 = 1/A_2 - (A_1/A_2 + N_2/N_1)\partial_1$, where $1/A_1$ and $1/A_2$ are the maximum number of molecules of the components which can be present in 1 sq. cm. and ∂_1 is the number of molecules of 1 in the surface layer per sq. cm. The observed adsorptions from alcohol-water mixtures are inconsistent with the hypothesis of monomolecular adsorption. The difference, however, between the requirements of the hypothesis and the observed adsorptions is small. A method is given of applying the equation of Gibbs to ternary solutions. For EtOH, aq., LiCl solutions it is shown that at small concentrations of LiCl there is present at the surface of solutions containing more than 6 mol. % of alcohol an approximately complete unimolecular layer of alcohol. The ions are separated from the under surface of this layer by a layer of solution, the thickness of which decreases as the alcoholic content increases, and which disappears in pure alcoholic solutions. This behaviour is attributed to the hydration of the ions. At higher LiCl concentrations the ions penetrate the surface to an increasing extent. F. J. W.

5316. Inner Adsorption in Crystals of Inorganic Salts. A. Koluschewa and P. Sewrugowa. *Kolloid Zeits.* 60. *pp.* 141–145, *Aug.*, 1932.—Balarew's theory of inner adsorption in crystals is confirmed experimentally by a study of the occlusion of K, Na, Ca, Cl, NO_3, $KMnO_4$, $NaMnO_4$ and $Ba(MnO_4)_2$ by $BaSO_4$. F. J. W.

5317. Adsorption of Argon by Amorphous Carbon. M. W. Travers. *Roy. Soc., Proc.* 137. *pp.* 294–297, *Aug.* 2, 1932.—The adsorption of argon on cocoanut shell charcoal has been measured at temperatures between 380° and 607° C. The adsorption isotherms are linear, and the energy change involved is 4500 cal./mol., as compared with 2000 cal./mol. to be expected from purely physical adsorption. There is thus no evidence for the existence of active points on the surface of the adsorbent. The initial rate of adsorption is high, but equilibrium is established only very slowly—after 12 days at 15° the pressure (400–500 mm.) continued to change appreciably—and it is suggested that true equilibrium is rarely obtained in adsorption experiments at ordinary temperatures. H. F. G.

5318. Sorption of Condensible Vapours by Porous Solids. Part I. Capillary Theory. A. G. Foster. *Faraday Soc., Trans.* 27. *pp.* 645–657, *Aug.*, 1932.—A consideration of the results of a series of investigations on the equilibria between dehydrated silica and ferric oxide gels and water, benzene and alcohol vapours [see Abstract 3959 (1932)]. It is concluded that the shape of the sorption isothermals is determined largely by the actual size of the pores of the adsorbent. If they are small the formation of a strongly adsorbed layer one or two molecules thick is sufficient to fill the entire internal volume, whereas if they are large the layer adsorption is followed by capillary condensation, until the pores are completely filled. Hysteresis appears to be associated with capillary condensation. The lack of reversibility is due to some delay in the formation of the meniscus during the addition of vapour to the system. The Kelvin equation is applicable over the descending portion of the hysteresis area. It enables isothermals for different liquids on the same adsorbent to be reduced to the same scale by plotting the capillary radius against the volume of sorbed liquid. These radius-volume curves can be made to coincide by displacement parallel to the axes. There is no evidence of condensation with reversible isothermals. F. J. W.

5319. Adsorption of Kations from Ammoniacal Solution by Silica Gel. I. M. Kolthoff and V. A. Stenger. *J. Phys. Chem.* 36. *pp.* 2113–2126, *Aug.*, 1932.—The study of the adsorption of kations from alkaline solutions is complicated by the following factors: (*a*) the gel dissolves even in dilute alkali, and changes its structure; (*b*) the adsorption equilibrium is reached very slowly, and is not reversible; (*c*) the pores of the gel may be obstructed by the formation of insoluble silicates; (*d*) the speed of adsorption and desorption of various ions and molecules may be different. The adsorption of Ca and Cu from ammoniacal solutions first increases with increase of NH_3 concentration until a maximum is reached. Ammonium salts decrease the adsorption of Ca and Cu by silica gel because they decrease the OH ion concentration, and the NH_4 ions tend to displace adsorbed kations. Salts of K and Na behave similarly. F. J. W.

5320. Static Sorption Isothermals. Adsorption of Carbon Dioxide by Charcoal. L. J. Burrage. *J. Phys. Chem.* 36. *pp.* 2272–2283, *Aug.*, 1932.—The adsorption isothermal of CO_2 on a steam-activated cocoanut charcoal has been measured at 25° C. over the pressure range 0·01 mm.–80 mm. The adsorption was completely reversible. Further, the isotherm obtained was discontinuous. F. J. W.

5321. Modification of the Freundlich Adsorption Isotherm. W. Rogers, Jr., and M. Sclar. *J. Phys. Chem.* 36. *pp.* 2284–2291, *Aug.*, 1932.—A modification of the Freundlich adsorption isotherm which brings it into a form suitable for easy application to experimental results. F. J. W.

5322. System Water-Phenol. Part I. Densities. O. R. Howell. *Roy. Soc., Proc.* 137. *pp.* 418–433, *Aug.* 2, 1932.—The densities of water-phenol solutions for various concentrations have been determined at 20°, 30°, 40°, 50°, 60° and 70°; the density-concentration curve resembles the isothermal of a gas near the critical point; density and temperature are related by $d_t = d_{20^\circ} + \alpha(t - 20) + \beta(t - 20)^2$, α and β varying with concentration, and plotted against it showing inflexions at the composition PhOH, H_2O, possibly due to formation of $[PhOH_2^{\bullet}][OH']$. The line of mean density of conjugate solutions is given by

$$d_t^{\text{mean}} = d_{20^\circ}^{\text{mean}} - 5\cdot75 \times 10^{-4}(t - 20) - 2\cdot50 \times 10^{-6}(t - 20)^2,$$

the lines of mean concentration by weight and by volume are also parabolic. The critical solution temperature and concentration are respectively 66·4° and 34·6 % of phenol; m.p. of phenol 40·85°. C. A. S.

5323. Solubility of Inorganic Salts in Liquid Ammonia at 25° C. H. Hunt. *Am. Chem. Soc., J.* 54. *pp.* 3509 3512, *Sept.*, 1932.—The solubilities of 17 salts of sodium, potassium and ammonium in anhydrous ammonia at 25° are determined to within 0·5 %. In general the solubility of the halides increases with increase of the atomic weight of the halogen, and falls in the order ammonium, sodium, potassium. The sulphates, carbonates and oxalates are insoluble, and the sulphites and cyanates only sparingly soluble. The solubilities in ammonia cannot be predicted from those in water. The solubility of ammonium nitrate in ammonia decreases continuously as water is added. H. F. G.

5324. Solubilities of Phosphates of Lead. M. Jowett and H. I. Price. *Faraday Soc., Trans.* 28. *pp.* 668–681, *Sept.*, 1932.—The solubilities of secondary and tertiary lead phosphates in water were determined. The determinations were made by an electrometric method, employing the quinhydrone electrode. The first ionisation constant of phosphoric acid at 37·5° C. was determined. Fluid lead amalgams were used in a rocking electrode vessel. It was shown that secondary and tertiary lead phosphates were in equilibrium at a phosphoric acid concentration of about 3·10 *M*. F. J. B.

5325. Constitution of the Copper-Silver Series of Alloys Examined Thermodynamically. F. H. Jeffery. *Faraday Soc., Trans.* 28. *pp.* 705–707, *Sept.*, 1932.—The constitution of the Cu-Ag series of alloys is the simplest possible: the liquid solution consists of monatomic molecules of Cu and Ag, the solid solutions consist of monatomic molecules of Ag dissolved in a lattice of monatomic molecules of Cu and *vice versa*. F. J. W.

5326. Formation of Colloidal Gold and v. Weimarn's Precipitation Theory. H. B. Weiser and W. O. Milligan. *J. Phys. Chem.* 36. *pp.* 1950–1959, *July*, 1932.—The applicability and limitations of v. Weimarn's theory is briefly considered from a theoretical standpoint, and also its inadequacy to predict results is shown in connection with the formation of colloidal gold by reduction. It is shown that the particles of colloidal gold formed by reduction processes are in general larger the higher the concentration of the gold salt employed. This is contrary to v. Weimarn's theory. J. K.

5327. Preparation of Colloidal Silver and Gold by Continuous H.F. Discharge. A. N. Fraser and J. Gibbard. *Canad. J. of Research*, 7. *pp.* 133–136, *Aug.*, 1932.—A new method of preparing metal sols, by the use of a continuous h.f. discharge of sufficient intensity to produce a sinusoidal spark, is described. Stable yellow colloidal silver and purple colloidal gold have been prepared, without a protective colloid, by this method. Chemical determinations have failed to indicate any silver oxide in the yellow silver sols. H. H. Ho.

5328. Structure of Bredig Silver Sols. Part I. J. Löffler and W. Pauli. *Kolloid Zeits.* 60. *pp.* 146–150, *Aug.*, 1932.—Silver sols have been formed by striking an arc under water and the influence of various electrolytes, such as NH_4OH, HCl, KCl, on the structure of the sols studied. F. J. W.

5329. Structure of Cellulose Acetate Gels from Studies of Diffusion. K. Klemm and L. Friedman. *Am. Chem. Soc., J.* 54. *pp.* 2637–2642, *July*, 1932.—The structure of gels of cellulose acetate in benzyl alcohol is determined by measuring diffusion into the gels with time. It is shown that the diffusion law holds for the penetration of the employed diffusates into cellulose acetate gels. The diffusion coefficients obtained support the diffusion equation employed in the investigation. Comparison of the results obtained is made with the data obtained for gelatin and agar-agar systems. J. K.

5330. Silicic Acid Gels. Part II. C. B. Hurd and P. S. Miller. *J. Phys. Chem.* 36. *pp.* 2194–2204, *Aug.*, 1932.—The time of set is given for various mixtures of solutions of six different commercial silicates with acetic acid at four different temperatures. The soda-silica ratios range from 1 : 4·0 to 1 : 1·63 mol. ratio. The temperatures employed are 0°, 26°, 40° and 56° C. The effect of temperature on time of set is shown to be the same, regardless of the soda-silica ratio. A value is obtained for a quantity analogous to Arrhenius' heat of activation for a homogeneous chemical reaction. The average value is 16,640 cal. A theory for the mechanism of formation of a silicic acid gel is suggested. [For Part I see Abstract 2610 (1932).] J. K.

5331. Particle Form and Size from Viscosity and Flow Birefringence. W. Kuhn. *Zeits. f. phys. Chem.* 161. *Abt.A.* 1–2. *pp.* 1–32, *Aug.*, 1932.—In a liquid with a flow gradient, suspended particles exhibit, besides translation, also rotation round their mass centres. If the cross and long dimensions are equal this rotation is uniform, but as the length of the particle increases, the rotation becomes increasingly dependent on the position (angle) of the axis of the particle in the field of flow. Brownian movement acts against this orientation. As a first approximation, when the flow gradient is slight, an orientation below 45° to the direction of flow is favoured, no matter whether the particles are almost round or elongated; with higher flow gradients the orientation turns towards the direction of flow, and an equation is deduced from which the length s of the particles may be found. The forces set up on rotation and translation of the particles are evaluated with the help of models composed of rigidly-linked balls, the validity of the results being shown by comparison with the relations holding strictly for ellipsoids. The relative velocities of separate parts of the corpuscles in relation to the surrounding liquid, occurring on rotation of the particles, exert additional forces on the liquid and increase its viscosity. This is great with highly elongated particles and negligible with spherical particles ($s = d$), and with the former the ratio $s : d$ may be deduced from the viscosity. Thixotropy (dependence of viscosity on the flow gradient) is explained by the formation of chains or networks by loose aggregation of the particles in the liquid, such chains being broken down at high gradients. A relation which is derived between viscosity and flow gradient is confirmed experimentally and renders it possible to determine the order of magnitude of the tenacity with which thixotropically-held particles are retained. Determinations of the length of colloidal particles from flow birefringence data agree with those made in other ways. T. H. P

5332. Modified Method of Counting Particles. L. H. C. Tippett. *Roy. Soc., Proc.* 137. *pp.* 434–446, *Aug.* 2, 1932.—The method consists in making counts only on zones with few particles, all with more than a certain number, t being classed together; the mean is estimated from the modified frequency of distribution so formed. If n_0, n_1 . . . , n_t and n_r be the proportionate frequency of zones containing 0, 1, . . . t, and $> t$ particles, $n_p = n_0 + n_1 + \ldots n_t$, and m' is the mean particles per zone it is shown that $m'n_p = \hat{m}(n_p - n_r\hat{n}_t/\hat{n}_r)$, where $\hat{m}$, $\hat{n}_t$, $\hat{n}_r$ are the values of m, n_t and n_r estimated from observation by assuming the Poisson law. Determinations of m by aid of nomograms, of the standard error, applicability of the Poisson distribution and applications are discussed. C. A. S.

5333. Cryolysis of Lyophile Colloids. H. B. Bull. *Zeits. f. phys. Chem.* 161. *Abt.A.* 3. *pp.* 192–194, *Aug.*, 1932.—In v. Smoluchowski's equation, the viscosity is expressed by

$$\eta_S = \eta_M\left\{1 + K\phi\left[1 + \frac{1}{\lambda\eta M r^2}\left(\frac{D\zeta}{2\pi}\right)^2\right]\right\},$$

where η_S is the viscosity of the colloidal solution, η_M that of the pure liquid, ϕ the volume of the particles in unit volume of the colloidal solution, λ the specific conductivity, r the radius of the particles, D the dielectric constant, ζ the electrokinetic potential and K a constant. It is found that the part of the equation concerned with the electrical changes amounts to $2 \cdot 15 \times 10^{-3}$ for egg-albumin and to $5 \cdot 45 \times 10^{-3}$ for gelatin. As these values are considerably below unity, only Einstein's portion of the equation, $\eta_S = \eta_M(1 + K\phi)$ remains to be considered. Although this does not always allow quantitative statements to be made, it is applicable for qualitative purposes. T. H. P.

5334. Variations in Extinction Coefficients during Jelly-Formation. S. Prakash. *J. Phys. Chem.* 36. *pp.* 2483–2496, *Sept.*, 1932.—Variation in extinction coefficient has been investigated and the percentage of light transmitted calculated at intervals during the process of jelly-formation with ferric, chromic, aluminium and zirconium hydroxides; thorium, stannic and ceric arsenates; stannic phosphate; thorium, ferric and zirconium molybdates; zirconium borate and mercurisulpho-salicyclic acid. The jellies form three classes: (1) perfectly transparent jellies with no change in extinction coefficients during or after gelation; (2) jellies opalescent at setting and becoming increasingly, and sometimes completely, opaque with time; (3) jellies obtained from clear sols, but becoming opaque before or on setting. The transparency or opacity of the jellies is explained on the basis of the tendencies of the jelly-forming particles to undergo hydration or agglomeration. The tendency to hydration results in transparency, and that to agglomeration to opacity; balancing of these two tendencies yields translucent jellies. When the opacity increases even after setting, the extinction coefficients vary continuously, no break in the curve marking the setting point. Hence the processes of gelation, setting of the jelly and subsequent ageing appear to be continuous. Differentiation between jellies, gels, clots and curds on the basis of their transparency is regarded as inadequate, since one and the same jelly may be opaque or transparent according to slight alteration in the conditions. T. H. P.

5335. Electrical Theory of Atomic and Molecular Forces and Chemical Relationships. F. London. *Congrès International d'Électricité, Paris, Sect.* 1. *Rapport No.* 24. [18 *pp.*], 1932.—Comparison is first made between atomic and molecular forces on the one hand and astronomical forces on the other, following which comes a consideration of the statics and dynamics of the problem. Forces at large distances, *i.e.*, molecular forces, are next dealt with at length, and finally forces at average distances, *i.e.*, valency forces which are discussed under the conceptions of rigid atoms, directed and induced valencies and the principles of construction and structure of molecules. H. H. Ho.

5336. Nature of the Chemical Bond. Part IV. Energy of Single Bonds and Relative Electron Negativity of Atoms. L. Pauling. *Am. Chem. Soc., J.* 54. *pp.* 3570–3582, *Sept.*, 1932.—This paper continues previous work [see Abstracts **3034** and **3131** (**1932**)], and, after discussion and definition of extreme ionic bonds and normal covalent, records values of the energy of twenty-one single bonds which are obtained from experimental values of heats of formation and combustion of gaseous molecules by the use of the assumption that the energy of formation from separated atoms of a molecule to which a single Lewis electronic structure can be assigned is the sum of constant terms representing the various bonds. The postulate of the additivity of the energies of normal covalent bonds is then formulated, and it is found that deviations from additivity, Δ, are positive for all bonds and increase as the ionic character of the bond increases. An assignment of atoms to positions on a map representing relative degree of electronegativity is then made with the use of the Δ-values, according to the equation $\Delta_{A:B} = (x_A - x_B)^2$, where x_A and x_B represent the coordinates of atoms A and B on the map. Values of the energy of twenty bonds for which experimental data are not available are predicted by means of this equation, and a number of questions regarding the structure of molecules are discussed. H. H. Ho.

5337. Chemical Action in the Glow Discharge. Part IX. Reaction in the Crookes Dark Space and Negative Glow. A. K. Brewer and P. D. Kueck. *J. Phys. Chem.* 36. *pp.* 2133–2140, *Aug.*, 1932.—The chemical action taking place in the Crookes dark space and the negative glow of the ordinary glow discharge has been measured for the synthesis of NO_2. The distance from the kathode within which no appreciable reactivity occurs is shown to be equal to the length of the Crookes dark space. The reactivity per unit volume of the discharge is a maximum at the beginning of the negative glow, and thereafter decreases exponentially through the glow. A new method has been suggested for calculating the number of positive ions in the negative glow. The ratio M/N is equal to 2. [See following Abstract.] F. J. W.

5338. Chemical Action in the Glow Discharge. Part X. Decomposition of Nitrous Oxide. P. D. Kueck and A. K. Brewer. *J. Phys. Chem.* 36. *pp.* 2395–2405, *Sept.*, 1932.—The rate of decomposition of N_2O in the glow discharge is independent of the initial gas pressure and is proportional to the current; it may be expressed $dP/dt = \alpha I$, where P is the pressure at time t, I the current, and α a constant. The effect of added N_2, O_2, A and He on the rate of reaction is such that the ratio of the observed rate to the rate in pure N_2O is equal to the ratio of the concentrations of N_2O^+ ions formed in the mixture and the pure gas. The reaction appears therefore to be initiated by N_2O^+ ions and to be little affected by N_2^+, O_2^+, A^+ or He^+ ions. The ratio M_{N_2O}/N_{N_2O} is 4. It is suggested that a cluster of the $(4N_2O)^+$ type is formed which dissociates in part directly to N_2 and O_2 and in part either to NO_2 and N_2 or NO and N_2. [See also Abstract **1443** (**1932**) and preceding Abstract.] F. J. W.

5339. Measurement of Pressures Developed in Explosion Waves. C. Campbell, W. B. Littler and C. Whitworth. *Roy. Soc., Proc.* 137. *pp.* 380–396, *Aug.* 2, 1932.—Experiments on the shearing of copper foils of various thicknesses by explosion-waves in a number of different gaseous mixtures seem to provide a method of comparing the explosion pressures existing in the flame. By calibrating these foils by means of static air pressures, direct values of explosion pressures have been determined which agree fairly well with those calculated by Jouguet's method, especially in the case of the more dilute mixtures. The effects of the values of the heats of reaction and the formulæ for the specific heats of gases at high temperatures on these calculated pressures are discussed. Photographs of the flame before and after the copper foils in certain cases give approximate values for the times required to shear them. Pressures near the point of detonation are higher than in the fully established explosion-wave. H. H. Ho.

5340. Propagation of Explosion Waves through a System of Glass and Rubber Tubes. C. Campbell, A. King and C. Whitworth. *Faraday Soc., Trans.* 28. *pp.* 681–688, *Sept.*, 1932.—The velocities of explosion of H_2 and N_2O, and mixtures of CH_4 and C_2H_4 with O_2 were studied. C_2H_2 and CO were used with different amounts of O_2. The explosions were carried out in glass and rubber tubes, the rubber tubes being of different thicknesses from 0·023 cm. to 0·2 cm. The propagation of the explosion waves was photographed by means of a revolving drum. The results showed that explosion waves in "non-striating" mixtures can pass through considerable lengths of even very thin rubber tubing without any appreciable alteration in velocity. "Striating" mixtures on the other hand showed a marked reduction in flame velocity on passing through rubber. The flame velocity was dependent upon the thickness and length of the rubber. F. J. B.

5341. Ignition Point of Active Carbon. E. Berl and E. Weingärtner. *Zeits. f. phys. Chem.* 161. *Abt.A.* 4–5. *pp.* 315–324, *Sept.*, 1932. —The authors describe the method employed to find the relation between ignition point in air of active C and the surface area and degree of graphite formation of the C. The method consisted in heating 2 c.c. of C of particle size 2 to 3 mm., and as free from water as possible in a constant, slow stream of air. The ignition temperature is determined from the sudden change of direction of the temperature-time curve. To determine the ignition point more accurately than is possible with a thermojunction alone, they place a Haber-Löwes gas interferometer in the air stream from the combustion vessel. A diagram of the apparatus is given, together with curves and tables of results. The conclusions reached are: (1) The ignition point decreases generally with increase of surface; and (2) the ignition point is higher the greater the extent of graphite formation in the active C. The degree of graphite formation is determined by the decrease in electrical resistance. This relation is affected by the particle size. The ignition temperature is lower when there is a large formation of graphite and a large surface. T. B.

5342. Heat of Formation of Nitrous Oxide. T. C. Sutton. *Phil. Mag.* 14. *pp.* 275–285, *Aug.*, 1932.—N_2O is exploded with an excess of H_2 at fairly high pressure (> 30 atm.) by means of a fine thread of cordite wrapped around a platinum wire, and the heat effect is measured with a special calorimeter. After making the necessary corrections for O_2 in the H_2 and N_2O, and for NH_3 in the products, the heat of the reaction $N_2O + H_2 = N_2 + H_2O$ (liquid) at constant volume is found to be $88 \cdot 3 \pm 0 \cdot 32$ k.cal./mol.; the calculated heat of formation of N_2O is $-20 \cdot 5 \pm 0 \cdot 3$ k.cal./mol. H. F. G.

5343. Heats of Formation of Indium Trioxide and Germanium Dioxide. G. Becker and W. A. Roth. *Zeits. f phys. Chem.* 161. *Abt.A.* 1–2. *pp.* 69–76, *Aug.*, 1932.—By burning the highly pure metals in the calorimetric bomb, the heat of formation of $[In_2O_3]$ is found as 222·5 k.cal. (± 0·33 %) and that of $[GeO_2]$ as 128·1 (± 0·5 %) at 20° C. and constant pressure. Both values show the ∼-shape of the curve connecting serial number and heat of formation for the third and fourth subsidiary groups. The heat of formation of $GeCl_4$ is calculated to be 124 k.cal. The specific heat of pure indium at 24° C. under water is found to be 7·28 ± 1 %. [See Abstract 3047 (1932).] T. H. P.

5344. Heat Capacity and Free Energy of Formation of Ethylene Gas. M. E. Haas and G. Stegeman. *J. Phys. Chem.* 36. *pp.* 2127–2132, *Aug.*, 1932.—The specific heat of ethylene at constant pressure has been measured over the range 0° to 70° C. The results can be expressed by the equation $C_p = 4 \cdot 064 + 0 \cdot 02022T$. The free energy of formation of ethylene is then calculated to be $\Delta F = 17{,}790 + 11 \cdot 436T \log_e T - 0 \cdot 0054T^2 - 67 \cdot 6T$. F. J. W.

5345. Heat of Formation and Structure of Carbon-Oxygen and Carbon-Sulphur Linkages. W. Lochte-Holtgreven and C. E. H. Bawn. *Faraday Soc., Trans.* 28. *pp.* 698–704, *Sept.*, 1932.—The energy of the CS and the CO linkage in COS were determined by photochemical methods. The photochemical dissociation of COS led to a normal CO molecule and an excited sulphur atom. The absolute heats of formation of the $C = O$ and the $C = S$ bonds in CO_2 and CS_2 are calculated from the thermochemical heats of the ideal dissociation process, that is, complete dissociation in one stage. The force constants and the heats of linkage of the CO and CS bonds in CO_2, COS and CS_2 show that all the bonds in these molecules were doubly linked. F. J. B.

5346. Apparatus for Quantum Yields of Gas Reactions by Actinometry. G. S. Forbes, G. B. Kistiakowsky and L. J. Heidt. *Am. Chem. Soc., J.* 54. *pp.* 3246–3249, *Aug.* 1932.—Apparatus and experimental method for determining the quantum yield of a photochemical gas reaction over any time interval in terms of the quantum yield of uranyl oxalate in monochromatic light of the same wave-length, with a probable error of 5 % are described. J. S. G. T.

5347. Quantum Yield in Photochemical Decomposition of Alkyl Halides. W. West and Beatrice Paul. *Faraday Soc., Trans.* 28. *pp.* 688–697, *Sept.*, 1932.—The quantum efficiencies for the photochemical decomposition of the lower alkyl halides in hexane solution in the absence of oxygen were studied. The liberated halides were determined by titration. The quantum efficiencies were found to vary with the nature of the radical from a value of a few hundredths for methyl iodide to more than one for *iso*-propyl iodide. The yield increased with diminishing wave-length between 3130 and 2610 Å. and at these wave-lengths it was independent of temperature. No parallelism was observed between the readiness of

oxidation and of undergoing decomposition in absence of oxygen. The employment of benzene as a solvent did not markedly diminish the yield.
F. J. B.

5348. Theory of the Glass Electrode. Part II. M. Dole. *Am. Chem. Soc., J.* **54.** *pp.* **3095–3105,** *Aug.,* **1932.**—The glass electrode is directly compared with the hydrogen electrode in acid solutions of sodium chloride and sulphate, lithium chloride, aluminium chloride and sulphate, hydrochloric acid, sulphuric acid and in acid ethanol water mixtures. A comparison is also made over a wide pH range in a solution of NaI dissolved in ethanol. The errors of the glass electrode in acid solutions are not a direct function of the nature or concentration of any ion present, including the H-ion. The errors in alcoholic solutions are similar to the errors in acid solutions. Previous theories to explain these errors are reviewed and rejected. It is found that the acid solution errors are a function of the activity of the water; reduction of the activity of the water makes the error more negative in accordance with: $\Delta E = RT \log_e a_{H_2O}/F$. Because of this the glass electrode can be shown to act as a perfect water electrode at constant pH. Mathematical analysis of the results indicates that as the H-ion migrates through the glass it carries exactly one molecule of water along with it, *i.e.*, the H-ion or proton is hydrated in the glass. By combining the equation for the glass electrode in acid solutions with that for alkaline solutions [see Abstract **2194** (**1932**)], an equation for the glass electrode over an extensive pH range is obtained. H. H. Ho.

5349. Depolarisation Effects by Hydrogen and Oxygen at Platinum Electrodes. J. A. V. Butler and G. Armstrong. *Roy. Soc., Proc.* 137. *pp.* **604–621,** *Sept.* 1, **1932.**—A study is made of the anodic and kathodic polarisation of Pt electrodes in solutions saturated with H_2 and with O_2, using currents of a few mA per cm.^{2}. The observed behaviour is interpreted on the basis of the theory of the effect of depolarisation processes on the rate of change of potential. On the anodic polarisation of electrodes which have previously been kathodically polarised in H_2-saturated solutions, two depolarisation processes are observed at potentials more negative than that at which the steady liberation of O_2 occurs. These processes are ascribed respectively to the electrolytic solution of adsorbed or dissolved H_2 and to the formation of a layer of adsorbed O_2. On kathodic polarisation of an electrode which has previously been anodically polarised one such process is observed which marks the removal of the adsorbed layer of O_2. E. E. F. d'A.

5350. Antimony Electrode. S. Bodforss and A. Holmqvist. *Zeits. f. phys. Chem.* 161. *Abt.A.* **1–2.** *pp.* 61–68, *Aug.,* **1932.**—The Sb electrode in the form of metallic Sb in a buffer solution cannot, as usually assumed, be an oxide electrode, since the dependency of the pH in such solution appears in solutions in which the Sb_2O_3 cannot be present as solid phase. It is probable that the electrode has no influence on the concentration of its own ions and that the antimonyl ion, $SbO^{\cdot}$, can scarcely determine the potential. In dilute HCl, KCl exerts a marked salt effect. At the same pH the potential may be conditioned by the anion of the acid and probably also by its concentration (anion effect). Rest measurements with electrolytically prepared Sb (from fluoride) and fresh ground surfaces of the cast metal show potentials more negative than those of the cast or amalgamated metal. The application of Sb to the determination of pH is hence impracticable. T. H. P.

5351. Antimony Electrode. W. Böttger and L. v. Szebellédy. *Zeits. f. Elektrochem.* 38. *pp.* 737–742, *Sept.*, 1932.—The use of the Sb electrode for the determination of pH values was studied for a series of electrodes prepared by different methods. It was shown that the various Sb electrodes showed marked differences in their behaviour when used for the determination of pH and for acid-alkali titrations. A new method of preparation of the Sb electrode is described. The new electrode rapidly takes up the correct potential and is applicable to determinations of pH and to acid-alkali titration. F. J. B.

5352. Standard Cells. H. v. Steinwehr. *Congrès International d'Électricité, Paris, Sect.* 2. *Rapport No.* 8. [26 *pp.*], 1932.—The various standard cells are briefly considered. The standard Clarke and International Weston Cells are described. Methods for the preparation of the standard cells, purification of the materials used in their construction and preparation of the saturated solutions are given in detail. Temperature effects on the voltage and the effect of excess of acid on the e.m.f. of the Weston cell are discussed. The international determinations of the e.m.f. of the Weston cell are described, and the constancy of the cell as a function of time is indicated. F. J. B.

5353. Sulphates of Mercury and Standard Cells. R. B. Elliott and G. A. Hulett. *J. Phys. Chem.* 36. *pp.* 2083–2086, *July*, 1932.—The preparation of mercurous sulphate for use in standard cells is discussed. In the method recommended a solution of $HgSO_4$ is placed in a deep crystallising dish and SO_2 is allowed to flow slowly into the upper part of the solution; if the rate of flow is too high a precipitate is formed, but otherwise clear crystals of 0·5–1 mm. side are grown readily. The solution used consists of 1 : 6 H_2SO_4, 50–75 % saturated with $HgSO_4$. The crystals, after washing with dilute H_2SO_4, alcohol and ether, consist of pure Hg_2SO_4 and yield satisfactory results when used in standard cells. The variations reported between the constancy of e.m.f. of cells containing clear crystals and that of cells containing electrolytic mercurous sulphate are ascribed to the presence in the opaque material of finely divided mercury [see also following Abstract]. H. F. G.

5354. Hydrolysis of Mercurous Sulphate. O. B. Hager and G. A. Hulett [with R. B. Elliott]. *J. Phys. Chem.* 36. pp. 2095–2098, *July*, 1932.—At 25° C. the acidity of the solution in the system Hg_2SO_4-water-Hg is 0·002 *N*. To obtain the normal salt the solution must be not less than 2 *N* with regard to H_2SO_4. Repeated treatment of normal Hg_2SO_4 with 0·2 *N* H_2SO_4 yields a basic salt which causes a considerable decrease with time of the e.m.f. when used in a standard cadmium cell, and it is therefore not satisfactory to use in such cells commercial Hg_2SO_4 which has been treated with dilute H_2SO_4; even if 24 *N* H_2SO_4 is used part of the basic salt remains unaltered. [See also preceding Abstract.] H. F. G.

5355. Absolute Zero of Potential Measurement. E. Baur. *Zeits. f. Elektrochem.* 38. *pp.* 665–666, *Aug.*, 1932.—Discussion of recent communications bearing on this question leads to the conclusion that no reason exists for abandoning the accepted value, +0·56 volts, for the absolute potential of the normal calomel electrode. T. H. P.

5356. Automatic Control and Recording of Hydrogen-Ion Concentration. C. Morton. *Chem. Soc., J. pp.* 2469–2475, *Sept.*, 1932. —A potentiometric regulator is described for the automatic pH recording or control in which a glass electrode is employed. It is shown that powerful oxidising and reducing agents, suspended precipitates or colloidally dispersed substances and electrode "poisons" do not interfere with the accuracy of the method. A recording cell suitable for use with the glass electrode in continuously flowing solutions is described. F. J. B.

5357. Effect of Supersonic Radiation on Brom-Thymol Blue. A. R. Olson and N. B. Garden. *Am. Chem. Soc., J.* 54. *pp.* 3617–3620, *Sept.*, 1932.—It is shown that the observations of Liu and Wu [see Abstract 2641 (1932)] and of Schmitt, Johnson and Olson are not necessarily in conflict and that the variation of indicator and H-ion concentrations presents one explanation of the differing results. There is also the possibility that the brom-thymol blue obtained for use as indicator is not a homogeneous substance and that the compounds used by the two sets of experimenters differed. The results definitely prove that the H-ion concentration does change upon the destruction of the indicator.
H. H. Ho.

5358. Theory of Concentration Polarisation. B. Bružs. *Zeits. f. phys. Chem.* 161. *Abt.A.* 1–2. *pp.* 83–96, *Aug.*, 1932.—With the help of the assumption made in the solution of the Ludwig-Soret problem, that heats of reaction appearing in stationary systems are to be regarded as latent heats, an equation for the Hittorf effect (also for concentration cells with liquid potential) is deduced which contains only thermodynamic magnitudes and allows of the calculation of dilution-entropies of ions and salts from Hittorf coefficients or concentration cells with liquid potential. A method is given also for determining heats of dilution from isothermal cells. A satisfactory explanation for the phenomenon of anode sludge is given. T. H. P.

5359. Theory of Electrolytic Polarisation. H. Fricke. *Phil. Mag.* 14. *pp.* 310–318, *Aug.*, 1932.—It is known that the polarisation capacity and phase angle due to two electrodes placed in an electrolyte depends upon the frequency of the applied a.c. The author gives a theoretical explanation of this effect. Comparison of his calculations with experimental values gives good agreement. J. E. R. C.

5360. Velocity of Corrosion from the Electrochemical Standpoint. U. R. Evans and T. P. Hoar. *Roy. Soc., Proc.* 137. *pp.* 343–365, *Aug.* 2, 1932.—Measurements have been made of the corrosion velocity of vertical specimens of iron and steel in dilute aqueous solutions of KCl, NaCl, Na_2SO_4 and other salts. The corrosion-time curves are linear and the temperature coefficient is rather low. Curves connecting corrosion-velocity with salt concentration show a maximum velocity at about $0{\cdot}5\,N$; the area of the corroded region is, however, smallest in the range of most rapid corrosion—an apparent anomaly explained by the protection mechanism proposed previously [see Abstract 3266 (1931)]. In the range of high concentration, the corrosion is proportional to the oxygen-solubility—a fact which receives a simple theoretical interpretation, but at low concentrations it falls far below the calculated value. The corrosion rate is proportional to the current which the measured e.m.f. would force through the resistance of the circuit. Polarisation measurements have been obtained which make it possible to calculate the corrosion-velocity over the lower range of concentration where the proportionality to oxygen-solubility fails. General data agreement indicate that corrosion is connected with differential aeration currents set up between a kathodic area along the water-line, and an anodic area along the bottom and sides of the specimens. Bengough's results and conclusions from the study of horizontal specimens are held to be inapplicable to the vertical specimen data now obtained. H. H. Ho.

5361. Anodic Behaviour of Nickel. K. Georgi. *Zeits. f. Elektrochem.* 38. *pp.* 681–688, *Aug.*, 1932.—Not merely the magnitude of the potential of nickel immersed in dilute acid, but also the rate at which the potential is established, vary with the nature of the anion. The equilibrium potential of nickel against *N*-nickel sulphate and chloride solutions of pH 5 and 1, in atmospheres of H_2, O_2 and N_2, and the loss of weight of the electrode, have been determined. The results indicate that owing to the low reactivity of the metal the formation of the hydrogen film on the surface of the electrode takes place relatively slowly. This view is supported by measurements with electrodes coated with nickel peroxide, and by determinations of the voltage-current density curves under various conditions. H. F. G.

5362. Estimation of Nickel in Nickel Steels. A. Glazunov and J. Křivohlavy. *Zeits. f. phys. Chem.* 161. *Abt.A.* 4–5 *.pp.* 373–388, *Sept.* 1932.—An electrographic method for the estimation of nickel in nickel steels is described. The alloy under examination is made the anode and a plate of an indifferent metal serves as kathode. The electrolyte consists of an unsized paper saturated with dimethylglyoxime. The passage of the nickel ions into solution develops an intense scarlet coloration, which is compared with the colour produced by alloys containing accurately known amounts of nickel. F. J. B.

5363. Silver Voltameter. G. W. Vinal. *Congrès International d'Électricité, Paris, Sect.* 2. *Rapport No.* 6. [25 *pp.*], 1932.—The history of the silver voltameter is reviewed, and the various types of the apparatus are considered. The characteristics, purity, solubility of the deposited silver in the washing water are discussed. Comparisons are made between the deposit of silver on platinum and on gold. Details are prescribed for the use of the silver voltameter and the accuracy of the measurements are shown by a series of measurements. F. J. B.

5364. Theory of Surface Conductance at an Electrolyte-Solid Interface. K. S. Cole. *Physics*, 3. *pp.* 114–118, *Aug.*, 1932.—An expression has been derived on the basis of the Maxwell–Boltzmann distribution and Poisson's equation for the tangential surface conductance of an electrolyte in contact with a charged plane surface. One part of this expression is analogous to the result given by Smoluchowski for a Helmholtz double layer, while the second part arises from the movement of the ions in the diffuse ion cloud under the applied electric field. The theory shows qualitative agreement with the data of Briggs for the conductance of univalent chloride solutions at a cellulose surface. For all but the most dilute solutions, the Smoluchowski term is negligible and the surface conductance is proportional to the charge density on the surface. The theory does not agree with the data for different anions and it is suggested that the discrepancy may be due to adsorption phenomena. There may be a movement of the adsorbed ions or of a diffuse ion cloud resulting from the presence of adsorption potentials at a distance from the interface. AUTHOR.